THE

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## ELECTRICAL REVIEW.

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THE

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## LIMITS OF SHOP PRODUCTION.

COMMENTING on the decision of Messrs. Willans & Robinson to close their steel works, the *American Machinist* points out the danger of a works extending in undesirable directions. The mere fact that steel enters so largely into the construction of a steam engine or of a boiler, is no reason for the engine-builder or the boiler-maker himself entering into the manufacture of what is to him raw material.

Steel is not merely the raw material of the engine-builder; it is a material which demands a very special knowledge and training on the part of those producing it, and its manufacture also requires to be carried out on a considerable scale. Unless, therefore, the owner of the works has an enormous call for his own production—such as, for example, the large demand which the London and North-Western Railway has for the rails it rolls for itself—it is not easy for him to make his own raw material.

In the case of an engine-builder setting out to make steel, he must go into the outside market to sell his surplus product and keep his works producing steadily. Otherwise he will run the works inefficiently, and his steel will cost him very much more than the price at which he can buy it in the open market. In going into the open market to sell his surplus product, every one of his engine-building competitors knows he must sell this surplus product, or lose, and he will get no orders from unfriendly rivals except at the very lowest price. Nor is it likely they will be very anxious to give him orders at any price. They will not want him to know too much of their own business, nor will they be too anxious to place themselves at his disposal in respect of the quality he may send them, or the time of delivery he quotes. Altogether he is, in fact, practically cut out of the very department of the business for which he is best equipped, and he must seek outside sources of work. Raw material at such rates must inevitably prove costly to the maker.

Generally, in respect of the making of one's own raw material, it seems probable that this should be confined within the narrowest possible limits. The whole secret of modern methods is specialising, and there are numerous works to-day where even the foundry is looked on as an undesirable excrescence—as, in fact, a provider of raw material that ought to be obtained elsewhere. If manufacturing engineers would all agree to buy their castings, it would be possible for a few large foundries at each iron centre to equip themselves in the best possible manner, and to turn out castings at a price with which no works department foundry could compete. The spirit which embodies a foundry of small size in nearly all engine shops prevents the growth of first-class independent foundries. Many shops make their own bolts, but such things as bolts can usually be made more cheaply by regular bolt-makers. A general rule for any machine shop is to make nothing but the

product actually sold, buying raw material and much half-raw material from specialist makers outside.

To return to the case of cast-iron. Cast-iron is made in the blast furnace, and large numbers of cast-iron articles are cast directly from the blast furnace without the intervening process of re-melting in the cupola, with its expenditure of coke. We believe the Carron Co. cast cylinders for steam engines, bedplates, and frames direct from the furnaces. Glasgow pipe founders run pipes direct from the blast furnace. The tube segments of the London tube railways are cast direct from the blast furnace, and there is a good profit on such casting in the saving of the cupola coke of the ordinary founder.

Could a machine shop keep a cost of its castings, including supervision, rent, interest, and maintenance, we fancy there are very many cases where castings would come out dearer than if purchased. The establishment of a foundry, or other semi-raw material department, occupies capital that might be more advantageously employed on direct production. The direct product of an engine shop is engines, not castings. The boiler shops aim to sell finished boilers, not steel plates, and the rolling of steel plates is no more a part of a boiler business than the production of steel or iron castings is a part of an engine business.

To be successful in manufacture, all the energy of a works needs directing on that product which is sold. It is in the sale of that product that the whole financial position of the works must stand or fall. We do not say that buying is not as important as, or is second only in importance to, selling. But the energy spent on branch departments would be better spent on a good buying department. After all, if a works runs its own foundry, there is as much skill required in buying pig-iron for the foundry as there is in buying castings.

In devising a systematic manufacture, it is, therefore, desirable to start out with the aim of making and selling one product, to which end the location of the works must be such that that product can readily be shipped away, and there must also be facilities for getting in raw materials. Many firms have put up their own foundries simply because they have been badly situated for readily procuring castings. It is therefore desirable that such arrangements should be made as will prevent too much sending to and fro of patterns. Castings themselves only cost more than pig-iron according to their classification, but patterns, if sent to and fro, are an expense, and it is desirable that the services of a pattern shop should be available near or at the founders, capable of altering patterns to blue-prints so as to minimise costs.

Obviously, the success of this organisation depends on the organisation of the drawing office, and by the drawing office should be understood not merely the drawing and designing, but the inspection of the shop product, and the buying of material. The raw material stores should really be a department under the drawing office, but we are quite aware that the drawing office, as too frequently understood, consists merely of a regretfully kept ill-ventilated room, with flat chested anæmic men in it, who are kept in ignorance of everything, if possible, that is done in the works.

The failure of the German system is that the draughtsman does not follow out his work in the shops, and he does not enjoy the valuable privilege of hearing shop criticisms of the little or great practical errors he may make in design. He never hears of what occurs in the shop or outside. If a design is changed he does not have the reason why put before him.

In many shops there is a want of correlation between departments. Faults go on for years. In the old days of chipped and filed fits, pattern shops always so made their patterns that the fit was often secured after all the chipping strips had been cut off. The actual fitted surfaces rarely showed anything of the strips remaining, and often there had to be excursions into the solid. It never was possible in such shops to get patterns so made that the solid parts were as they should be, about one-eighth of an inch below size, and brought up as much over size by means of $\frac{1}{4}$-in. strips. This is but one sample of the sort of thing that goes on in many places.

Lack of organisation, and too diffuse a supervision such as will occur when there is too much making of semi-raw material, account for some of this faulty working. In commencing to manufacture, it is better to start on the actual product, buying everything except the final machining and fitting. Departments should only be added under pressure, and the closest investigation should be made before indulging in a costly enterprise.

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The Corrosion of Aluminium and its Prevention.

About a year ago Burgess and Hambuechen showed, in *Electro-chemical Industry*, that a film forms over an aluminium anode in certain solutions, such as that of sodium acid phosphate. This film has been examined by W. R. Mott, who, writing in the same journal, states that it is different in nature from the skin that appears on the metal after exposure to air, and that it possesses higher protective powers. Strips of sheet aluminium about 10 sq. cm. in area were coated with the film by immersion in the solution of the phosphate when under the influence of an electric current at 125 volts, and the plates so "formed" were tested side by side against ordinary surfaces of the same metal as regards their power of resisting the attack of hydrochloric and sulphuric acids and sodium hydroxide employed in "normal" strengths. The alkali acted at a nearly equal speed upon both the formed and the unformed plates; but the hydrochloric acid corroded the bare sheet 100 times faster than the one which had been formed. After one hour's action, however, the speed of attack on the unformed plate is only six times that on the other; and, after two hours, the rate of action is practically the same on both. The corrosion of the formed plates seems to start in spots, to spread under the film, and to split it off; the places still covered by the film are uneaten by the acid. Sulphuric acid acts 1,000 times as rapidly on the bare as on the protected plate, and disodium phosphate behaves identically. Experiments were also tried on forming the plates at different voltages, and exposing them to the current for different periods of time. With a direct current, the pressures ranged from 1 to 100 volts, and the time of treatment from 10 to 70 minutes; with an alternating current, the voltage (measured by voltmeter) ranged from 10 to 150, and the time of immersion from 10 to 80 minutes. The relative degree of protection attained was estimated by washing and drying the strips, then placing them in a eudiometer with normal hydrochloric acid, and measuring the volume of gas given off every 10 minutes. The curves so obtained show that the protective action is directly proportional to the voltage at which the plate is formed, and the author is of opinion that the very decided decrease in the corrosion of aluminium observed after this treatment would be still more pronounced were the active reagent sodium chloride (common salt). He therefore suggests that all domestic articles made of aluminium, such as cups, combs, objects with handles, &c., should be given this protective coating, which should also be valuable for the preservation of bare electrical conductors of aluminium which run near the sea. Further mechanical, physical, and chemical details are promised on a future occasion.

## TECHNICAL EDUCATION: LONDON AND BIRMINGHAM.

By C. ALFRED SMITH, B.Sc., A.M.Inst.E.E.

Engineers, by the very nature of their calling, are uncommonly practical men. Those who are to be found in large works often are possessed of the erroneous notion that their *confrères* who are engaged upon the task of training the young idea possess sufficient theory to do all the research work concerning some of the partially understood laws which govern many knotty problems. This is not always the case. Recently, Mr. Reginald Morcom, of the firm famous for quick-revolution engines, expressed the opinion (in his admirable paper on the equipment of an engine test-house) that, in many cases, manufacturers possessed the knowledge for which professorial brains were wearing themselves out. But many men fight shy of the theoretical aspect of a question. The interest of such in technical education may be stimulated by reading about two very great and almost opposite experiments about to be made in the training of engineers.

"An ounce of practice is worth a ton of theory" is certainly a proverb which appeals strongly to the British race. Well, in five years' time we shall see the practical results of the two rival theories for engineering education; and, in order that they may be followed more closely, and with greater interest, it may be well to explain the systems which either do obtain, or will shortly obtain, at London and Birmingham, for these two cities, by means of the curriculum at each university, will be the centre of what should be a healthy, vigorous, yet rival system of education.

It may be asked at the outset, "Why compare these two?" The only reason is, that they are each trying entirely different systems of education, under almost entirely similar conditions. Both universities are essentially for students from that great middle class, which come from the homes maintained on incomes under £1,500 a year. No expenditure of money, no tremendous local enthusiasm, will ever create for these two modern universities, situated in the great streams of life, the tradition, the atmosphere, the calm of the undergraduate life at either of the two older universities. "And why Birmingham?" Because technical education is to be carried out at that university at a greater cost, on a more lavish scale, than at any other place in Great Britain. London seems to be wedded to what is called "the sandwich system," while Birmingham is catering for both theory and practice. London seems to say to the technical student, "Go into the works for so many months each year," but Birmingham is building workshops at the university—machine and erecting shops, a foundry, a forge, a pattern shop, and a by no means small central station. In the author's humble opinion, it is the latter—to be used as a heat laboratory—which will prove the scheme's salvation, the trump card. The workshops *may* succeed, but the unique heat laboratory *must* succeed. Do not confuse the issue, it is a simple one. It seems to be accepted in London that it is hopeless to attempt to teach a technical student, in a thorough manner, the practical portion of his work. Perhaps it would be more correct to say, "the handling of ordinary workshop tools and appliances," for of course the London colleges include that very practical but often under-rated portion of college training, common to both systems of education, the laboratory work. But the great parting of the ways comes at the word "workshop." Birmingham offers to teach the undergraduates the work of the foundry, forge, wood and metal shops, and has spent some tens of thousands of pounds on this special feature alone. "Only the workshop practice—never the workman's ways," is the thought which passes through one's mind when walking through the large workshops at Birmingham, now almost completed. And if you ask them there for an opinion, they tell you, "Yes, *after* our four years' course, he will yet want a year in the works—but so do the Americans." So that it really comes to a five years' training, very similar to that which, for 40 years, was so wonderfully successful, the old Admiralty Keyham system; except that at Keyham the last, or final year, is the "graduating" year, and the workshops are almost entirely deserted by these fifth-year men. Note the Birmingham scheme carefully—four years of lectures, laboratory *and* workshops, at college, after which the youth, if successful, graduates. For a fifth year he is advised to enter some large works as an improver, he will certainly not get more than a pound a week for that year.

Now for the London "sandwich system." For six months each year the youth has lectures, laboratories, &c., but no college workshops. Then he goes into a works for six months; in some cases at 10s. a week. And so, for the four years, does the theoretical and the practical training alternate—but if the lad be smart he is being paid for his services during the summer six months. This may mean much to some of the sons of households of limited means and strenuous lives. And then, for the fifth year, he takes his place, on practically the same footing as his rival from Birmingham, at probably the same rate of pay. But the four summers spent in the workshops have given him an easy familiarity with the manners, or lack of manners, of the workshops and his "mates," as he must call them. He has been inoculated with the commercial spirit so apparent in a large works, so lacking in the usual college workshop. He has been subjected to that finest of character-moulders—discipline, which is seldom seen in a college workshop. He has seen the inside of, lived within, a human hive—a place where the relentless law of "the survival of the fittest" is carried out in a manner unknown at college; he has seen the struggle for existence, he has learnt that time has a price. But, if a weak character, he may have learnt in those four half-yearly visits to the large works some of the evils which a year or two later would have been to him no temptation. He will have probably found it difficult to settle down to his studies after six months' rough and tumble in the shops.

The one point which will appeal to many is the fact that, while the Birmingham man must pay substantial workshop fees, the London or "sandwich system" man gets paid for using the same tools; so that, if the lecture and laboratory classes cost about the same in each case, the "sandwich" man scores. At present it is too early to judge. Difficulties there will be with both schemes; possibly each will stimulate the other to greater exertions. In the equipment of laboratories Birmingham has spent lavishly. Is it too much to hope that London—where Davy, Daniell, Faraday and many other famous men have worked—will be supplied with the funds necessary to start level in this respect with her smaller provincial rival? London, with its millions of inhabitants, its highly specialised professorial staff, attracting, not one here and there, but a continuous stream of young technical students from the Colonies, and even the Far East, and which, if only there were sufficient money for proper laboratory extension at the Strand or Gower Street for the special equipment for engineering research, would attract young graduates from the United States and the universities of Europe for post graduate work—this London has a wonderful opportunity in the re-constituted university which the provinces can never obtain. And yet the great schemes, the developments so badly needed, are being kept back for the want of generous support.

Although Birmingham, by the local patriotism of her citizens, has the advantage of some hundreds of thousands of pounds recently spent on the scheme of technical education out-lined above, it by no means follows that she is spending the money wisely. Some of us think that she is, others will criticise the huge workshops severely. But all will admire the great and bold experiment—time alone can show which of the two schemes will be the more successful. We can only hope that London will profit by the energetic example set by the metropolis of the Midlands.

## CAST WELDED RAIL JOINTS.

It is astonishing how little progress the welded joint has made in England. Consulting engineers have it in their power to introduce it to any extent, but notwithstanding the evidence available, they seem to be one and all anxious for the other man to risk his reputation.

A little article by Mr. Herrick in the *Street Railway Journal*, of March 5th, will be of some assistance to the

engineer who requires both convincing and teaching; perhaps we should have said simply teaching, for he who is not convinced on any matter is not fully taught, although indeed it is too evident in everyday life that the majority of people express themselves convinced before the first lesson is finished, and henceforth close their minds to the reception of further facts on that particular subject.

After several years of experiment and experience in actual practice, the essentials which go to make welded joints successful, are mostly known, and it goes without saying that the reasons of previous failures have been discovered in the process.

In the first place, before attempting to cast weld at all, the composition of the rail should be determined, so that its self-hardening properties may be judged.

If it is deficient in this property, no welding should be done, as it is sure to turn out a failure from the speedy development of low joints and soft spots where permanent annealing has occurred.

If complete fusion is to take place at the weld, sufficient metal must be run into, or through, the mould to ensure the temperature of the mass not falling below the critical point before the rail-ends have reached this temperature; and modern cast-welds stop below the head of the rail, so that the danger of annealing this part is not so great as it was when the whole height of the rail was enveloped in molten iron.

Improvements in moulds have removed the trouble which used to arise from chilled casts.

The Goldschmidt thermit weld is superior to the cupola weld on the score of smallness of plant and of metal at each joint, for the heat required to bring both the iron and the rail up to welding temperature is generated at the point of application, whereas, on the other system, the cast-iron is heated separately, and the heat for the rail is abstracted therefrom.

Experience in America hardly favours casting joints in rails laid in wood or asphalt paving, the lateral support being insufficient to prevent buckling at high temperatures. It remains to be seen whether the same thing occurs in wood paving in England.

Before the joints are welded, all the paving, except just at the joints, should be finished, and particular care should be used to make a solid foundation under the joints.

To obtain a resistance no higher than that of an equal length of continuous rail, the weight of metal in the joint must be $2\frac{1}{4}$ times the weight per yard of the rail.

Mr. Herrick's experience is that 2 per cent. of the welds break, and that these occur chiefly at the top of grades and at the end of tangents. Perhaps these might be reduced by special anchoring. If not it would be desirable to put bonded expansion joints at these places, for it is not pleasant to contemplate continually having to test for and make good breaks in the return circuit. That is where the awkward part of the cupola cast-weld system comes in.

Unless you own a welding plant, you either have to be content with bonding the joints which break, or you have to get the contractors to send their plant along every time, as it is unfortunately impossible to send the joint to the plant. The advantages of the thermit process are seen here.

We believe that Coventry continues to be very satisfied with its cast-welded track, and that has been done for quite a number of years.

## THE BRITISH EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS.

THERE is no doubt that a great many visitors to the Exposition will expect to see a really representative exhibit of Great Britain's products, but this is out of the question.

Expositions are looked at by manufacturers from a commercial and business standpoint, and, of course, from this point of view, foreigners stand a poor chance when they have to contend against the high tariff in force in the States.

The British exhibit includes apparatus used in almost every branch of the electrical industry, with the exception of dynamo-electric machinery. The apparatus is exhibited by various makers, on the invitation of the British Royal Commission, to illustrate in a measure the present practice, as well as the advance which has been made in recent years in testing, measuring, and recording electrical phenomena, both in the laboratory and in actual working.

The instruments have in most cases been tested at, and have received certificates from, Lord Kelvin's laboratory, the National Physical Laboratory, and Dr. Muirhead's works, the latter dealing specially with submarine telegraph instruments.

The British Postal Telegraph Department is exhibiting a set of instruments illustrating the progress made in the transmission of telegraphic messages from 1883 to the present time.

There is a working model of Mr. F. B. Behr's mono-railway and high-speed car as authorised by Act of Parliament for the railway between Manchester and Liverpool, a distance of 70 miles, to be worked at a speed of 110 miles per hour, the run to be accomplished without a stop.

There are exhibits of switchboard apparatus by the Consolidated Electrical Co.; also samples of electro-chemically made reflectors and copper tubes, and samples produced by the electro-galvanising process by Mr. Sherard Cowper-Coles.

Various lamps and X-ray and high-frequency apparatus are exhibited by Mr. A. C. Cossor; and submarine telegraph apparatus, with the latest Kelvin siphon recorder, are shown by Messrs. Muirhead & Co.

There are some very fine pieces of apparatus exhibited by the Cambridge Scientific Instrument Co., including oscillographs, temperature recorders, and various electric recorders for laboratory use.

Messrs. Crompton & Co., Ltd., are exhibiting very high-class potentiometer sets, having accuracies that are really remarkable.

Messrs. Elliott Bros., who have the Weston electrical instrument business in Great Britain, are making a splendid exhibit of switchboard instruments of all kinds. Messrs. Nalder Bros. & Thompson, and Messrs. Everett, Edgcumbe and Co. are also showing a very excellent exhibit on the same lines.

The India-Rubber and Gutta-Percha Co., renowned all over the world for cable making and laying, are showing a very fine collection of cables as supplied for various American submarine cable companies and others.

Mr. F. Darton is showing a very fine induction coil giving a 10-in. spark in air, the coils being made up of 60 sections.

Of Messrs. Kelvin & James White, whose reputation is so well established, little need be said; their exhibit is typical of the high-class instruments they manufacture.

Messrs. Nalder Bros. & Co., and Mr. R. Paul have each a remarkably good show of testing and laboratory instruments adapted for the most accurate and reliable work.

There remains yet another exhibit which will enable us to keep up with the times, viz., an installation of electrically operated clocks on a simple and most reliable plan. These are exhibited by the Synchronome Co.

## DESIGN OF CONTINUOUS-CURRENT MOTORS FOR VARIABLE SPEED.

By FRANKLIN PUNGA.

THE question of the most economical construction of a continuous-current motor for variable speed has been discussed several times lately. In an article in *Electric Power*, November, 1903, for instance, the size of a motor with a speed variation of 4 : 1 is estimated to be 16 times that of a motor with constant speed. On the other hand, in an article contributed to the ELEC. REV., December 4th, 1903, MR. H. M. Hobart states that motors, the maximum speed of which does not exceed a certain limit depending upon the

output, may be designed for variable speed work, without costing more than the corresponding constant-speed motor. Whilst such a curve as was proposed by Mr. Hobart in the article referred to, is of great interest, two very important factors, *i.e.*, the ratio of maximum speed to minimum speed, and the voltage, do not appear to have received sufficient attention, and since they may change the nature of this curve to a great extent, the writer of this article intends to show—by a more detailed treatment of this subject—the lines on which variable-speed motors should be built.

A great deal of the divergency in the two estimates given above, may be explained by the fact that the one writer takes a standard motor for the maximum speed as basis of the comparison, whilst a motor for the lowest speed is taken in the second article. Of course, only the latter proceeding gives a fair basis of comparison, because the standard motor for the lowest speed would be larger than that for the higher speed.

The comparison itself should be based on the cost of the corresponding motors, and not on horse-power, as a variable-speed motor should be designed differently from the normal practice, and will generally not coincide with any constant-speed motor.

To estimate the cost of a variable-speed motor, one should first determine the most economical dimensions, this being by far the most important problem. The dimensions of the armature have to be chosen so that the commutation at the lowest speed is better than is necessary, as, by the increase in the speed, the frequency of the commutation, and, therefore, the reactance voltage also, is increased in the same ratio.

In fact, if $a$ is the ratio $\frac{\text{maximum speed}}{\text{minimum speed}}$, then the reactance voltage at the lowest speed should be $a$ times smaller than the maximum reactance voltage permissible.

It will be seen at once that the commutation is by far the most important factor in the design of a variable-speed motor, its influence being increased directly in the ratio $\frac{\text{maximum speed}}{\text{minimum speed}}$, and a few remarks concerning the reactance voltage and the factors governing it may be of interest.

How to calculate the reactance voltage from the given dimensions of a machine was first shown in "Electric Generators." Later on, the method has been modified so as to include the self-induction of the end connections. A very useful simplification has been proposed by Mr. Mavor, which will be used in this article, though modified to a certain extent, so as to make the result identical with that obtained by the method of Mr. Hobart. It is:—

Reactance voltage $= 2\pi \times$ frequency of commutation $\times$ inductance of one armature coil $\times$ current in one conductor.

Let the brush cover $n'$ segments, each segment possessing $n$ armature turns, and let $a$ in cm. denote the effective length of one turn and $b$ in cm. the free length of one turn; then we get, according to the method of Mr. Hobart:—

$$\text{Lines per ampere} = 2\,n\,n'\,4\,a + n\,n'\cdot 8\,b,$$
$$= 8\,n\,n'\,(a + \tfrac{1}{10}\,b).$$
$$\text{Inductance} = 8\,n^2\,n'\,(a + \tfrac{1}{10}\,b)\,10^{-8}.$$

Frequency of commutation $= \frac{\text{r.p.m.}}{2\,n'\,60} \times$ number of segments.

Therefore

$$\text{Reactance voltage} = \frac{2\pi\,8\,n^2\,n'}{120\,n'}\,(a + \tfrac{1}{10}\,b)\ \text{r.p.m.}$$

$\times$ number of segments $\times$ current per conductor $\times\ 10^{-8}$,

$$= \frac{4\pi}{60}\,n\,(a + \tfrac{1}{10}\,b)\ \text{r.p.m.} \times \text{armature amp.-turns} \times 10^{-8}.$$

From the equation—

$$E = 4\,\frac{\text{r.p.m.}}{60} \times \frac{\text{No. of poles}}{2} \times \text{flux per pole} \times \text{armature turns between brushes},$$

we obtain

$$E \times C = \frac{4\ \text{r.p.m.}}{60} \times \text{armature amp.-turns} \times \frac{\text{No. of poles}}{2} \times \text{flux per pole.}$$

$$= \tfrac{4}{8}\tfrac{1}{0}\ (\text{r.p.m.})\ \text{armature amp.-turns} \times \text{armature C.G.S. lines.}$$

From this formula we get for the reactance voltage the following:—

$$\text{Reactance voltage} = 2\pi\,n\,(a + \tfrac{1}{10}\,b)\,\frac{E \times C}{\text{Arm. C.G.S. lines.}}$$

This last formula indicates very clearly how a machine of excellent commutation properties can be constructed. The conditions are:—

1. The number of armature turns per segment is to be kept small.
2. The number of C.G.S. lines entering armature has to be large.
3. The effective length ($a$) of one turn as well as the free length ($b$) have to be small.

It is now comparatively easy to alter the design of a constant speed motor, so as to obtain a good commutation for variable speeds.

If the commutator cannot be increased in diameter and the width of a segment cannot be decreased, then the most effective way to obtain the end in view is to increase the diameter of the armature, keeping the length constant. For instance, increasing the diameter of the armature by 10 per cent. would permit the following changes:—Increase in the cylindrical surface of armature, 10 per cent.; increase in the number of magnetic lines of armature, 10—15 per cent.;* decrease in the number of armature turns, 10—15 per cent.; increase in the number of commutator segments, 10 per cent.; decrease in the number of armature turns per segment = 20—25 per cent.; total decrease of reactance voltage = 30—40 per cent.

The cost would have increased at the same time, roughly, by about 10 per cent., so that it will be readily seen that a great improvement in the commutation can be obtained by a small increase in the cost.

The above deductions are valid only if (1) mechanical difficulties do not prevent an increase of the armature diameter; (2) the corresponding constant speed motor has sparking for its limit of output; (3) the number of turns per segment is larger than one.

Mechanical difficulties will soon be met with in the construction of variable speed motors, because the ability to increase the speed means not only more revolutions per second, but in most cases also a larger diameter of the armature. More binding wire has to be employed on the armature, more precautions have to be used in insulating the coils, and, if the speed is to be increased further still, a point will be reached at which the construction of a motor with a moderate reactance voltage is impossible.

Condition (2) is obvious. If a constant-speed motor has not sparking for its limit of output, then, of course, such a speed variation may be obtained without extra cost, which will bring the reactance voltage up to its maximum amount.

The output of high-voltage motors is nearly always limited by sparking, whilst very often low-voltage motors may be built with a very moderate reactance voltage.

A semi-enclosed 10-H.P. 110-volt motor, for instance, running at 400 r.p.m., may be built with a reactance voltage as low as ·7 volt, and may be at the same time most economical in design. The reason is that, though a three times higher reactance voltage is permissible, the dimensions of the armature cannot be decreased because of conditions of heating, whilst the small gain in the construction of the commutator by using fewer segments is more than compensated by the advantage of using the same commutator in the high-voltage machines. Very often 250-volt machines also have a small reactance voltage, thus allowing a speed variation by shunt regulation.

Condition 3 refers to those motors in which only one turn per segment is employed. The reactance voltage in this case

$$= 2\pi\,(a + \tfrac{1}{10}\,b)\,\frac{\text{Int. } E\,C}{\text{Total C.G.S. lines of armature}},$$

or, abbreviated,

$$= 2\pi\,(a + \tfrac{1}{10}\,b)\,\frac{\text{Output in watts}}{\text{Total C.G.S. lines of armature}}.$$

The reduction of the reactance voltage of these motors is

* Larger than 10 per cent., because the magnetic density in the air can be taken higher.

considerably more expensive than it was in the case of several turns per segment, and amounts to about 12 to 15 per cent. for every 10 per cent. increase in cost. It is necessary to increase the diameter of the armature, and at the same time the magnetic density of the air-gap. The length of the air-gap should be made as small as mechanically possible, because the number of the distortioning armature ampere-turns in a well-designed motor is very small.*

We have, therefore, to consider three stages if the required maximum speed is more and more increased :—

1st stage.—No extra cost is necessary. The reactance voltage of the normal motor for the lowest speed is smaller than necessary, then the speed may be increased until the maximum reactance is reached.

2nd stage.—If a greater range of speed is required than is possible in stage 1, the dimensions of the motor must necessarily be increased. But for every 30 to 40 per cent. increase in the range of the speed, the cost of the motor will be increased by 10 per cent. only.

3rd stage.—Begins as soon as the number of turns per segment comes down to one. Then an increase in speed of only 12 to 15 per cent. corresponds to an increase in cost of 10 per cent.

These general considerations will appear again, modified to a certain extent, in the practical construction of a variable speed motor, say a 7-H.P. 125-volt semi-enclosed motor, with a lowest speed of 300 r.p.m.

To give a general idea of the size of the constant-speed motor, the following specification has been framed, giving all those dimensions that are of importance for the comparison of a standard motor with a variable-speed motor :—

| | |
|---|---|
| Output (H.P.) | 7 |
| Volts | 125 |
| Speed in r.p.m. | 300 |
| No. of poles | 4 |
| Diameter of armature | 280 mm. |
| Length of armature between flanges | 200 mm. |
| Number of ventilating ducts | 3 |
| Width „ „ | 10 mm. |
| Effective length of armature | 153 mm. |
| Number of slots | 42 |
| Dimensions of slot | 25 × 11 |
| Maximum width of tooth | 9·9 mm. |
| Minimum „ „ | 6·2 mm. |
| Number of conductors per slot | 32 |
| Number of turns per segment | 4 |
| Bare diameter of wire | 1·8 mm. |
| Insulation | DCC |
| Type of winding | Drum, parallel winding |
| Air-gap | 2½ mm. |
| Pole-pitch | 224 mm. |
| Pole arc | 157 |
| Ratio of pole arc to pole-pitch | 70 % |
| Cross-section of magnet | 145 cm² |
| Diameter of commutator | 220 mm. |
| Number of segments | 168 |
| „ „ per slot | 4 |
| Width of a segment | 3·3 mm. |
| Flux per pole | 1·67 meg. |
| Apparent density in teeth | 22,000 |
| Corrected „ „ | 20 500 |
| Density in the pole-face | 5 300 |
| „ „ magnet | 13,700 |
| „ „ yoke | 12,000 |
| Effective length of one turn ($a$) | 30·6 cm. |
| Free „ „ ($b$) | 66 cm. |
| $a + \frac{1}{10} b$ | 37·2 cm. |
| Turns per segment | 4 |
| Internal voltage = 125 = armature drop | 108 |
| Current of armature | 52·5 |

$$\text{Reactance voltage} = 2\pi \frac{4 \times 108 \times 52{\cdot}5 \times 37{\cdot}2}{2 \times 1{\cdot}67 \times 10^6} = 1{\cdot}58 \text{ volts.}$$

The safe limit of the reactance voltage of motors with parallel winding lies between 3·0 and 3·5 volts, provided that hard carbon brushes are used. Let us assume the limit to be 3·5 volts, then the same motor may also be used for speeds up to $300 \frac{3{\cdot}5}{1{\cdot}58} = 665$ r.p.m. without sparking.

If a further increase in the range of speed is required, then a larger motor has to be taken, giving at 300 r.p.m. a smaller reactance voltage than 1·58 volt.

I have already pointed out that the required motor does not coincide with any constant speed motor for any output. In fact, such variable speed motors are, when most economically designed, quite abnormal machines, differing from constant speed motors, principally by the liberal employment of iron and by the very small amount of armature copper. These motors will have a crowded magnet frame, especially if the required range of speed is large. The density in the air-gap is extremely high, whilst the armature strength in ampere-turns per pole is extremely small.

A very extreme case may be taken to illustrate these points; two designs have been worked out, with the constant speed 7-H.P. 125-volt motor as a basis, with a view of obtaining a very small reactance voltage. The motor in column A has a diameter of armature of 40 cm., whilst the diameter of the motor in column B is increased to 50 cm. Both designs have only one turn per segment.

| | A | B |
|---|---|---|
| No. of poles | 4 | 4 |
| Diameter of armature, mm. | 400 | 500 |
| „ „ commutator, mm. | 315 | 392 |
| Width of a segment, mm. | 3·3 | 3·3 |
| No. of segments | 240 | 300 |
| No. of segments per slot | 4 | 4 |
| No. of slots | 60 | 75 |
| No. of conductors per slot | 8 | 8 |
| Bare diameter of wire, mm. | 2·2 | 2·2 |
| Dimensions of slot | 20 × 8·5 | 20 × 8·5 |
| Minimum width of tooth | 10·3 | 10·8 |
| No. of turns per segment | 1 | 1 |
| No. of armature turns between brushes ($T$) | 60 | 75 |
| Flux at the lowest speed $M = \frac{E}{4\,T\,N} 10^8$ | $4{\cdot}67 \times 10^6$ | $3{\cdot}75 \times 10^6$ |
| Apparent density in teeth | 22 000 | 22,000 |
| Cross-section of teeth carrying flux | 212 | 170 |
| No. of teeth per pole | 15 | 18·75 |
| No. of teeth carrying flux | 12·4 | 15·45 |
| Effective length, cm. | 16·5 | 10·1 |
| No. of ventilating ducts | 3 | 3 |
| Width of ventilating duct, mm. | 10 | 10 |
| Length of armature between flanges | 21·5 | 14·2 |
| Cross-section of magnet | 385 cm² | 310 cm² |
| „ „ yoke | 467 | 375 |
| **Densities.** | | |
| Apparent density in the teeth | 22,000 | 22,000 |
| Corrected „ „ | — | — |
| Density in pole face | 9,150 | 8,950 |
| „ magnet | 14,500 | 14,500 |
| „ yoke | 12,000 | 12,000 |
| **Reactance Voltage.** | | |
| Turns per segment | 1 | 1 |
| Internal voltage | 112 | 112 |
| Current from commutator | 52·5 | 52·5 |
| Effective length of one turn ($a$) | 33 | 20·2 |
| Free length of one turn ($b$) | 78 | 98 |
| $a + \frac{1}{10} b$ | 40·8 | 30 |
| Total number of C.G.S. lines of armature | $9{\cdot}34\ 10^6$ | $7{\cdot}5\ 10^6$ |
| Reactance voltage | ·162 | ·148 |
| Cost of motor | £95 | £90 |

Each of these two designs would give a ten times smaller reactance voltage than the original motor, at nearly double the cost. Such a motor would be limited in its range of speed by mechanical difficulties rather than by sparking, even if sufficient allowance is made for the fact that at high peripheral speeds of the commutator conservative values of the reactance voltage have to be taken.

A comparison of the two designs themselves shows that the motor in column B is not only cheaper but has also a smaller reactance voltage than the motor in column A, but the fact that the peripheral speed is 20 per cent. higher would in many cases induce the makers to adopt design A. This extremely favourable result (a reactance voltage of ·162 or ·148 volt at a speed of 300 r.p.m.) is due to a great extent to the low voltage of the motor. A 220-volt motor would have about double this reactance voltage at the lowest speed, and the reactance voltage of a 500-volt motor would be four times as high. The question would arise

* Mr. J. N. Dodd in a letter to the Elec. Rev., Vol. 53, p. 937, considers the distortion of great influence on the sparking. This is not the case, as long the commutation is effected by the contact resistance of the brushes; the only serious effect of the distortion is the dependency of the speed upon the load within certain limits.

whether it is not preferable to deviate from the ordinary practice as regards commutation, at any rate for high voltage motors having a great range of variable speed.

There have been prepared several appliances for the prevention of sparking, and those that are based on a sound theory may well find profitable employment in variable speed motors of a wide range, whilst their use for standard motors is prevented by the expense exceeding the next larger size of standard motor.

Practical and reliable data of these proposals are difficult to obtain, but in a few years' time, when the continuous current generator directly coupled to steam turbines has been developed further, these data will be common property and the variable speed motor will enter into a different stage.

One appliance may be mentioned which deserves careful attention for variable speed motors, the more so because its use is neither connected with patent expenses nor with any extra cost of construction, namely, the smooth-core motor, which admirably fits the requirements of the variable speed motor, because the amount of copper employed is very small in these motors, causing only a slight increase of the air-gap. These motors should be designed with small diameter and large length of armature, as this affords the greatest advantage to the use of smooth-core winding.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week.*

### The Charing Cross Fatality.

I am glad to notice that you consider this should not be left as "inexplicable."

Might I be allowed to suggest that it would be a far better plan for an "accident" of this kind to be inquired into by a committee of gentlemen who are experienced in the working of H.T. plants, and who would better understand the circumstances of the case than an ordinary coroner's jury.

There are several points which it would be interesting to know—such as whether the nine fuses were all in parallel, or whether they were on separate trunks, also whether any of the motor-generators were running at any of the sub-stations, &c.

It seems to me perfectly absurd to suggest that the victim's face was scorched by a "static charge," although I have on several occasions observed the presence of such a charge (especially immediately after the shutting down of a 10,000-volt plant), but have never seen anything in the nature of a spark large enough to burn a person's hair (except when removing or inserting fuses under pressure, which I have several times had occasion to do).

E. H. T.

### Electrical Works in Belgium.

We have read with some surprise the paragraph appearing in your issue of the 8th inst. under the above title.

The important position occupied by your journal in scientific literature, and the care which, we believe, you are accustomed to exercise in the verification of reports, lead us to think that such a damaging statement concerning this company should have been withheld from publication pending the receipt of precise information as to our financial situation, and the technical means at our disposal for carrying out an installation such as that required for the City of Brussels.

Attacks by a Press assured of the sympathy of the German competition, little concern us, but we cannot lightly regard damaging statements appearing in a journal of your standing. We therefore regret that in giving publicity to the paragraph referred to, you did not take into consideration the prejudicial effects which might be produced by the publication of such a report in a responsible organ.

During the last 15 years this company has carried out in the principal countries of the world, private and public installations of considerable importance, and amongst the latter, we are glad to be able to refer to many important central stations erected by us in your country. We are also very proud to have in our possession gratifying attestations as to the excellence of our work by many English municipalities.

We are constantly in competition with the most powerful Continental houses, and our offers very frequently receive the preference. Our shops are abundantly provided with remunerative work, and our books show orders in hand for several months to come.

It is true that our shares have fluctuated recently, but the cause of this is easily traceable to the general state of the market, and is not in any way due to lack of work or funds. We think it is hardly necessary to add that the fluctuation of a share on a market affected by numerous extraneous influences, is not always an infallible guide to the value of an industrial undertaking.

We therefore affirm that we are in a position, both from a technical and financial point of view, to undertake the complete installation for the City of Brussels, and a visit to our works, or to some of the large electrical installations which we have carried out, would convince you or your readers as to the truth of our statement. We hold ourselves completely at your disposal for this purpose at any time you care to appoint.

**Compagnie Internationale d'Electricité**
**Société Anonyme.**
J. Warrica.
Henri Pieper.

Liège, *April 14th*, 1904.

[The comments which appeared in our issue of April 5th, were published on the authority of a "Continental Correspondent" who, we had good reason to believe, was reliable. We need hardly say that when news is received from correspondents about whose *bona fides* there is no doubt, we do not consider it necessary to verify their statements. A proof of the above letter was sent to our correspondent and the reply received amounts to the following:—He fails to see grounds for the complaint, and remarks that the fact of the Société Anonyme Electricité et Hydraulique having withdrawn from the group tendering for the Brussels central station, in the opinion of the *Etoile Belge* puts the Cie. Internationale out of competition for the contract. If the German trust is endeavouring to monopolise the Belgian market, the Cie. Internationale is rather to be pitied. Our correspondent is not a shareholder in the company, disclaims the slightest animosity against it, and is glad to learn from the above letter that the shops are abundantly provided with remunerative work. But if the 500-fr. shares are only worth 134·50 fr. and work and funds are plentiful, is the general state of the market sufficient to account for the low quotation? We hardly think that the Cie. can legitimately complain about the quoting of the prices of the shares, for such information is public property and is a guide to investors, and, *ipso facto*, if the Société Electricité et Hydraulique goes into the trust, the "obligations" should be worth 500 fr., and therefore, as an investment, are well worth buying at 320. The comments referred to are simply an account of current talk in certain Continental financial quarters, and as such, presumably, are within the legitimate sphere of the Press.—Eds. E.R.]

### Institution of Electrical Engineers.

It often appears to me that there are quite a number of so-called members of all grades proposed and enrolled in the above Institution who, I contend, are totally unfitted and unworthy to be connected with an Institution of such sound principles, and are members only for their own selfish ends and to the common detriment of other members.

I could relate instances of one or two cases in question, where candidates who have been successful, do not tend to the welfare of and maintain the lofty ideals demanded for this scientific institution. I believe that their only motive in so joining was to create, if possible, some little sensation with their ill-gotten title, and to obtain charge of some electrical undertaking, to the detriment of those who have had already to go through the necessary training and routine.

I would, therefore, suggest that proposers of such candidates would use every precaution to prevent undesirables from entering. I conclude by asking the opinions of other members who are anxious for the welfare of our worthy institution.

**Electro-Vital.**

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### Recent Developments in Metal Conduits for Electric Light Installations.

It appears to me that Mr. Waterhouse's critics have either not read his article carefully, or have failed to grasp what he stated very clearly. Incidentally, I agree with him that in matters of this sort *noms-de-plume* are not always satisfactory. This brings me to the letter signed "B. F.," and, dismissing the personal remarks at the commencement as unnecessary and trivial, I should like to state that the three expressions quoted neither show inconsistency, nor demonstrate that the author does not quite mean what he says. That wood-casing "requires special labour at a high rate for its erection, which is necessarily slow," is a fact. A good joiner receives more than a "pipe-slinger," and that his work is necessarily slower is also a fact that cannot be traversed. Again, "the one thing that can be said in its (wood-casing's) favour is its economy in first cost" is a truism that "B. F." has misunderstood. The author clearly refers to the cost of material—not of *system erected*. Finally, "there was an all-round demand for something that would reduce the high cost and time taken in erection" points so clearly to the cost of *labour only* in erecting wood-casing, that it is difficult to understand how "B. F." can arrive at the conclusions he does, except on the premises I have made. To sum up, wood-casing *per se* is cheaper than socket joint conduit, but the extra cost of its erection more than compensates for its economy in first cost of material; therefore the cost of a socket-joint installation is less than the cost of a wood-casing installation—a fact established long ago.

**V. Zingler.**

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### Jerry Wiring.

The following copy of advertisement appears in to-day's London *Daily Chronicle*, "Situations Vacant" column :—

**MEN (Young) without Trade.—How to become electric wireman; good pay and prospects. Write, enclosing addressed envelope, Foreman Electrician, 7, Carthew Villas, Hammersmith.**

This Foreman Electrician is evidently anxious to continue the "Jerry" wiring business that has retarded progress in the electrical industry for years past.

**A. Ewer,**
GENERAL SECRETARY, *Electrical Trades Union.*

London, E.C., *April 18th*, 1904.

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### Tramways and Compulsory Running Powers.

There is going to be a big legal battle on the above question. A conference of enterprising tramways committees is to meet at an early date in London to discuss the line of action.

Now is the time for our municipal tramway undertakings, without exception, to combine and protect themselves against selfish private enterprises and monopolists who are endeavouring to make "lawful" the compulsory agreement of running powers.

While the line of action to be worked upon has not yet been formulated, and probably will not be definitely decided upon for some weeks, a suggestion may not be out of place.

Why not form a Municipal Tramway Association before it is too late, and each and every tramway undertaking subscribe, say, a sum of £250 to £500, to a common fund to fight their just cause through Parliament; such a sum is insignificant compared with the question at issue, and to the sum already spent even on the smallest tramway undertaking in the country.

Is it fair and just to expect a few enterprising Corporations like Manchester, Glasgow, Newcastle, and about three or four others to fight a cause which is for the common welfare of municipalities and the public?

All should join together and present a strong, united, bold opposition, with unlimited capital to justly uphold what they think is right.

Every Corporation tramway manager in Great Britain ought, without delay, to bring this suggestion before the notice of his Committee.

It is a question of vital importance as to whether the municipal tramways (who are now practically in the embryo state and just breathing success) are to be probably set back for years by an unjust burden being thrown upon them.

It is a fight: on one side are selfish private interests whose sole object is money, and who, to gain their own ends, are trying to compel Corporation tramways to grant them privileges; on the other side, are the municipal tramway undertakings who are working for the welfare of the community at large.

Any man who has the interest of municipal tramways at heart should be up and doing.

**Wm. R. Bowker.**

*April 13th*, 1904.

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### Electricity Supply Accounts.

Mr. Burnett's letter reminds me that a week or two back the accounts of the Barking Electricity Supply Undertaking were analysed in the ELECTRICAL REVIEW, and I would be glad to know how the LET result was brought out as a deficit of £30. The official abstract of accounts, examined by the L.G.B. auditor, and passed by him as correct, showed a net credit balance of £19, not much to be proud of, I admit, but at the same time better than £1 on the wrong side.

As regards accounts generally, Mr. Burnett, rightly, I think, points out that under the system of analysis adopted by the ELECTRICAL REVIEW, an undertaking maintaining public lighting, private lighting and motors, is made to show less favourable results than the undertaking which does not maintain any public lighting, and which tells a consumer whose main fuse has blown, or whose motor has "gone to frame" to go to his contractor to get it put right, which may take a week.

As an example, take the case of an undertaking doing no maintenance outside its own power station and mains, and the same station maintaining public lighting and private installations.

| | No. 1. Without maintenance. | Per unit. | No. 2. With maintenance. | Per unit. |
|---|---|---|---|---|
| Output ... ... | 1,000,000 | — | 1,000,000 | — |
| Revenue ... | £12,000 | 2·9 | £15,000 | 3·6 |
| Generating costs | £3,000 | 0·7 | £3,000 | 0·7 |
| Distribution „ | £1,000 | 0·2 | £4,000 | 1·0 |
| General „ | £2,000 | 0·5 | £2,000 | 0·5 |
| Total „ | £6,000 | 1·4 | £9,000 | 2·15 |
| Percentage to revenue | 50 % | — | 60 % | — |

It is assumed that the costs of generation, management and maintenance of distribution system up to consumers' or public lamps' main fuse are the same in both cases, and it is obviously unfair to make it appear that because No. 2 undertaking is keeping in order other people's property besides its own (it is not a municipal concern) it is getting ·7d. per unit more revenue than No. 1, that its costs are ·7d. higher, and percentage of costs to revenue 10 per cent. greater. These are the figures by which an undertaking is judged, and I suggest that the costs of attending to public lighting and private consumers' installations should be omitted, and a corresponding amount deducted from the revenue, where no separate profit and loss account is shown.

I suppose, to be strictly correct, the accounts relating to this maintenance should be shown as though it were a separate department, and the net result included in the net revenue account.

I cannot agree at all with your remarks in your April 8th issue, as the cost of maintenance, running, repairs, &c., of the undertakers' own property is the total cost of production; the cost of maintenance of anything outside this cannot be held to be in any way a cost of production, it only being undertaken in the case of private consumers in order to save the latter the annoyance and loss of time and business, caused by want of prompt attention, and in the case of public lighting because it would hardly pay the lighting authorities to keep a repairing staff, especially when they also own the electricity undertaking.

Your remark that Mr. Burnett, having obtained a steady load in public lighting, is unwilling to admit the expense to which he has been put, is quite beside the point; you would hardly argue on the same lines if the load under discussion happened to be private lighting with a 10 per cent. load factor.

One other point in connection with analyses of costs, there is another anomaly, the "unit sold." With the increasing numbers of power stations supplying energy to tramways, and in bulk, measured either at the station or at a central distributing point, the term "unit sold" is misleading; for obvious reasons the "unit generated" cannot be taken, but I should imagine that if the "unit delivered" to the feeders at the power station switchboard were taken as a basis of calculation, it would enable more correct comparisons to be made.

**A. Hugh Seabrook,**
*Engineer and Manager.*

Barking, *April 12th*, 1904.

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### Barrow-in-Furness Municipal Electrical Supply.

With reference to the comments on above in your "Correspondence" column of this week's issue.

Item.—Private mains and services £226 included under Total Works Costs, as these are neither repairs, renewals nor depreciation, but purely an extension, the amount in the first instance should have been debited to capital, just in the same manner as any other mains extension or new services would have been, and as an amount was refunded for same from the consumers, capital account ought to have been credited with the original expenditure, and the amount received over and above this treated as a revenue; on the other hand, had the amount received been below the original expenditrue then the difference ought to have been debited revenue. This, I think, is a correct method of dealing with accounts of this description as they can hardly be called a working expenditure.

*Re* Public Lamps Account.—As stated in Mr. Burnett's letter, if this item is included in Total Works Costs, no fair comparison can be made between works having no public lighting and works having public lighting, therefore, to make a true comparison, I think the cost to the department for carbons, trimming, &c., on street lamps should be deducted from works costs. This should be done purely for the sake of comparisons, as with an increased output similar to that obtained from the street lighting, it is only natural to assume that the works costs would to all intents and purposes be practically the same without the addition of the extra expense entailed for the trimming carbons, attendance, &c., necessary for the street lamps.

**Accountant.**

*April 12th*, 1904.

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### Municipal Appointments.

Here are two recent additional illustrations of positions which were filled under "suspicious" circumstances. About two weeks ago the applications were invited for the appointment of general manager of a Corporation tramways (salary £300 per annum) in a city not 1,000 miles from Manchester.

For the purpose of appearance, evidently with the object of pretending to be genuine, they selected five candidates, amongst them one who is an assistant in the engineers department of that city; he is the man picked for the job, and has been since about Christmas.

Second case:—An enterprising city not 1,000 miles from Manchester advertised for a Parcels Superintendent (no salary stated); they picked 13 applicants, then reduced them to three, one of which was a gentleman of wide experience, and as an all-round man with such like experience, has no superior in the country; they cast him aside (not on a question of salary, because he was lower than the successful applicant) and appointed another man, at the same time telling the successful applicant (who came from a steam railroad) that as regards goods traffic on tramways, he could get all the information he desired from the very man (who is an experienced man in tramway parcels) whom they cast aside. It seems that the successful applicant had two or three testimonials from well-known M.P.'s, who, it is needless to say, possess no personal knowledge of tramway work, yet they recommended him. I could say more about this case which would surprise your readers, but refrain from so doing.

**Fair Play.**

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## PARLIAMENTARY.

### East London and Lower Thames Electric Power Bill.

This Bill came before Mr. Cawley's Committee of the House of Commons on April 13th. The promoters were represented by Mr. Balfour Browne, K.C., Mr. Ackworth and Mr. Lynden Macassay. Petitions against the Bill were lodged by the following:—Barking Town Council, Stepney Borough Council, Wanstead U.D.C., Woolwich Borough Council, Leyton Urban District Council, Grays Thurrock Urban District Council, Woodford Urban District Council, Essex County Council, Hackney Borough Council, Deptford Borough Council, Bermondsey Borough Council, Poplar Borough Council, Ilford Urban District Council, London Electric Supply Corporation, East London Waterworks Co., West Ham Corporation, Metropolitan District Railway Co., East Ham Urban District Council, several electric lighting companies of London, Greenwich Borough Council, Whitechapel and Bow Railway Co., London, Tilbury and Southend Railway Co., and the London County Council.

In opening the case for the promoters, Mr. Balfour Browne said that the Bill was to incorporate the East London and Lower Thames Electric Power Co. to erect three generating stations, mainly for power purposes, in the East End of London. There would be three generating stations eventually, but only one of them would be erected at first. One of the sites proposed was at West Ham. Then in order to supply the south side of the Thames, there would be a station at Greenwich, and the third would be at Grays. All the sites, it would be seen, were on the River; that was in order to get coal cheaply, and all of the stations would be within easy reach of the railway. There were a large number of local authorities opposing the Bill, and that was not the first time that the matter had been discussed in Parliament. Electricity for power purposes had commended itself to manufacturers all over the country, and some of the companies which supplied electricity for that purpose, and which had been established for a few years, were doing well. The question was whether power should be supplied by a company in places where a local authority had power to supply electricity for lighting purposes. It was on this question that the opposition of a number of the boroughs who petitioned against the Bill was founded. He would show that the matter had been decided by Parliament when four Bills were promoted some years ago. The matter was then sent to a joint committee presided over by Lord Cross, who came to the decision that the public advantages of electric power warranted the granting to undertakings of compulsory power to take land for generating stations. That Committee also came to the conclusion that the Board of Trade should grant provisional orders for that purpose, and that procedure by private Bill should be reserved for special cases. With regard to the liability for nuisance, a point raised by some of the petitioners, the Joint Committee considered that where land was compulsorily acquired, a company should not be subject to any further liability than that imposed by the Act of 1882, but that in the case of land acquired by agreement the company should be subject to the ordinary law. The Committee further said that compulsory power for landing might also be properly given where the site was not in the area of supply, and that where sufficient public advantage could be shown, power might be given over an area of several local authorities. That, he considered, set at rest the question as to whether such a Bill as that could proceed. Counsel then dealt with a number of precedents. Coming back to a consideration of the Bill itself, he said that the banks of the Thames were crowded with manufacturers and it was a wonder that such a Bill as this had not come to Parliament before. There were a number of traders, many of them large traders, who were prepared to take a great quantity of energy. Mr. Browne then dealt with the opposition of various electric light companies and railway companies. At the conclusion of his speech the Chairman asked if the Bill was opposed by all the local authorities.

Mr. Balfour Browne said that not all the local authorities were opposing, and many of those that were, were not appearing by counsel.

The Chairman: You are not supported by any?

Mr. Balfour Browne: I don't suppose we are! Would you expect it?—He had never heard of a local authority supporting a power company.

The Chairman asked if the capital was assured.

Mr. Balfour Browne said that there was no guarantee. It was impossible to show such a guarantee. No sound financier would think of backing a Bill until he saw what the Bill was going to be. Parliament might impose conditions which would render a Bill useless. What a financier wanted to see was that there was a custom for the commodity to be supplied.

The Chairman: What is the capital required by this Bill?

Mr. Balfour Browne: Two millions, Sir, but we shall not want the whole of this at once. I am told that about £300,000 is considered ample to build the first generating station and commence operations.

The Chairman: Which station will you erect first?

Mr. Balfour Browne: I believe that the station in West Ham will be the first.

Evidence was then called, the first witness being

Mr. John Cowan, the chairman and managing director of Messrs. Redpath, Brown & Co., engineers, of Manchester, Glasgow, and Edinburgh. His firm had works on the Thames, and he hoped to take electricity for power purposes from the company. He was prepared to support the scheme financially. Other manufacturers who were prepared to take power were then called, and the Committee adjourned, the Chairman suggesting that they would like to have some evidence that the scheme had adequate financial support on the next day.

On April 14th further evidence in favour of the Bill was called. Mr. Falconer, a solicitor, and chairman of the Mersey Railway Co., said that he considered the scheme had great prospects. He mentioned the names of various gentlemen who, he understood, would support the scheme by joining the board of the company. His support, he said, in answer to the Chairman, was conditional upon the granting of the whole of the area scheduled; and, further, if the Committee decided to grant the Bill, but limited it to the supply of power, he would have to reconsider his position. It might be difficult to get manufacturers to take current for power and lighting from two different sources. Two-thirds of the capital would have to be raised at once.

Mr. Lynden Macassay, for the promoters, said that he was instructed that only one station need be erected at first, as cables could be laid across the river.

Mr. H. A. Earle, a director of the Yorkshire Electric Power Co., having given evidence, the Chairman ordered the room to be cleared. After consulting in private, the Chairman, on the re-admission of parties to the room, said that the Committee desired to have witnesses who were prepared to support the scheme, and who were not promoters.

Mr. Balfour Browne then called Mr. C. H. Merz, the consulting engineer to the Newcastle-on-Tyne Electric Supply Co. He said that he was prepared to assist the scheme financially. He could induce some 50 or 100 persons to place £2,000 or £3,000 each as a nucleus to the necessary capital. He would not advise the promoters to proceed if any part of the scheme were cut out.

Mr. A. Campbell Swinton was also called in support. He could underwrite, or get underwritten, some £50,000.

On April 15th Mr. W. Rigby was called, and said that he was willing to support the scheme to the extent of £10,000.

The Committee having consulted in private for a few minutes, the Chairman announced that they had come unanimously to the decision that the preamble of the Bill had not been proved.

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### London, Camberwell and Dulwich Tramways.

A Select Committee of the House of Commons had this Bill under consideration on Thursday, April 14th. Mr. Honoratus Lloyd, K.C., opened the promoters' case. The Bill, he said, was for power to re-construct for electric traction the tramways now in the hands of the London, Camberwell and Dulwich Tramway Co. The lines were authorised by several Acts during the eighties, and owing to the decision of the London County Council not to purchase, they had been practically derelict for many years. Several attempts had been made by the Camberwell Borough Council and the London County Council to get the lines pulled up.

Mr. Sellon, the engineer, described the lines, and said that they could be made to pay if worked by themselves, and with no connection with any other lines. In 1885 the company were authorised to make a tramway down Rye Lane. The existing line from Queen's Road to Lordship Lane took the passengers nowhere, but if it were continued down Rye Lane, it would bring the public to the London Brighton and South Coast and the London Chatham and Dover railway stations. The capital required was £120,000. The probable number of passengers that would be carried was 4¾ millions per annum. There was no competition whatever, except a 'bus or two.

On Friday Mr. Sellon was further examined. He said that the scheme would necessitate the widening of Rye Lane in certain parts. Comparing Peckham with Croydon to show the probable number of passengers that would be carried on the new tramways, he said that 6,000,000 passengers were carried annually on the Croydon tramways to North End, Croydon. The estimate for the present line was 5,000,000. The Committee adjourned.

On Monday Mr. Hutchinson addressed the Committee on behalf of the promoters. He said that the promoters regarded the tramways along the whole length of Rye Lane as very important to the future of the scheme. However, they would be prepared to carry out the remainder of the scheme, and to guarantee the capital, if the Committee rejected the line along Rye Lane. They had existing rights, however, which they did not wish to surrender. Certain points with regard to the widening of Rye Lane having been discussed, the Chairman said that, although the Committee had no great sympathy with the promoters, he must say that, from the point of view of public convenience, they had a fairly strong case. He was sorry that the L.C.C. had not seen fit to negotiate with the company for the absorption of the company. The company would be in the position of obstructing the construction of the lines, if the Bill were not passed, for several years.

Mr. S. Sellon continued his evidence, and put in plans showing the width of the roadway at various parts.

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### Cheshire Electricity and Power Gas Bill.

This Bill came before Mr. Cawley's Committee of the House of Commons on Monday, when there were a number of petitions against the Bill.

Mr. Shiress Will, K.C., in opening the case for the promoters, said that the Bill was to incorporate the Cheshire Electricity and Power Gas Supply Co., and to confer powers on the company. The object of the company was to supply electricity and power gas over the whole of the County of Cheshire. The capital of the company would be £1,000,000, with borrowing powers for one-third of that amount. The area of supply contained over 1,022 square miles, and included one city, three county boroughs, and affected 59 local authorities altogether. Out of the 59 there were comparatively few opponents of the scheme. Stockport was opposing the Bill on the grounds, as it alleged, that there would be no demand for power, but he would be able to show that there were a large number of manufacturers who would be willing to take power. A petition in favour of the Bill had been signed by a number of those manufacturers who together made use of no less than 11,890 H.P. The gas proposed to be supplied was Mond gas, and the electrical part of the scheme followed precedent. Electricity would be supplied to authorised undertakings only, and energy only to private persons. Although they were to be able to supply current to authorised undertakings, the company could not force it upon them, so that it could not be said that the company was competing with those undertakings. The promoters anticipated that there would be a large demand for electricity and Mond gas. They could generate electricity much cheaper than the small undertakings could, and those local authorities who wished would be able to purchase current from them. The company did not wish to have a monopoly of the district; and there was a provision in the Bill that the company should not oppose any application for a provisional order on the part of any local authority. Counsel then dealt with the gas part of the scheme, and, in conclusion, said that Cheshire was excluded from the North-Western Electricity and Power Gas scheme of last year on the ground that the capital of that Bill, £2,000,000, was insufficient for the whole of the undertaking.

Mr. John Sturgeon, M.Inst.C.E., was called, and said that he had had considerable experience of power distribution from a central station. He was called in by the International Committee on the Niagara scheme. The cost of running engines by Mond gas would be one-fourth of the cost of using steam raised by Welsh coal.

Cross-examined by Lord Robert Cecil, K.C. (for the Altrincham Electric Supply Co.): The gas would be of no use for lighting purposes.

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*Standing Orders.*—On April 14th, further Standing Orders were found to have been complied with in the case of the following Bills:—Nuneaton and Chilvers Coton U.D.C.; Metropolitan Railway; Preston, Chorley, and Horwich Tramways; Tyneside Tramways and Tramroads Bill; Tynemouth Corporation Bill; Leith Corporation; and Dundee, Broughty Ferry and District Tramways.

*Petitions.*—The Lancashire and Yorkshire Railway Co. has deposited a petition in the Private Bill Office in opposition to the Preston, Chorley, and Horwich Tramways Bill, and the Newcastle-upon-Tyne Corporation is opposing the Tyneside Tramways and Tramroads Bill.

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## OUR LEGAL QUERY COLUMN.

*[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]*

"Erimus" writes:—"A Corporation was granted an electric lighting order in 1898 by the Board of Trade under the Electric Lighting Acts of 1882 and 1888. Is the Corporation under the same compulsion to supply electric energy for motor or other power use, as for lighting use?"

*** Before giving a definite answer to the question addressed to us by "Erimus," it would be necessary to consult the provisional order under which the Corporation to which he refers now supplies electricity. Assuming, however, that the ordinary form has been followed, it would appear that the Corporation is bound to supply "energy," and this obligation is irrespective of the purpose for which the energy is required. Sec. 19 of the Electric Lighting Act, 1882, provides that where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided, every company or person within that part of the area, shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances, to a corresponding supply. It is further provided by Sec. 20 that the undertakers shall not, in making any agreement for the supply of electricity, show any undue preference to any local authority, company, or person. These are the obligations imposed upon the supply company or corporation. Of course, if the undertakers find it necessary to supply energy for motors, they may charge for the same at the rates which they are entitled to charge for electric light. As a matter of practice, however, the price per unit for motors is generally much reduced.

## LEGAL.

### A Traveller's Claim.

At Lambeth County Court, before Judge Emden, on April 14th, Richard Vivian, a traveller, sued Robert Pries, trading as Durtnall and Pries, electricians, 82, Bunhill Row, E.C., for illegal dismissal. Plaintiff stated he was engaged by defendant, in January, at £2 a week and commission. He was summarily dismissed on March 5th on the plea that he did not bring in sufficient orders. As a matter of fact, witness's business was not to get orders, but to get defendant's leave to send in quotations. If Mr. Pries made these quotations too high it was not plaintiff's fault.

Defendant said he advertised for a traveller with a good connection. Plaintiff replied, and was engaged at £2 a week. He was to get orders for wiring, &c., to the amount of £80 a month, and was to have 5 per cent. commission on any orders obtained over £80 a month, also he was to receive 2½ per cent. on all goods sold. Witness found Vivian absolutely incompetent and without a connection. During the nine weeks he was there he only brought in work to the amount of £8 15s.

Plaintiff said that through him, defendant had the opportunity of quoting for work totalling £1,730; but his quotations were always too high.

Defendant produced a copy of the Electrical Review, showing that within the last few weeks his tender was the lowest of a number sent to the Camberwell Borough Council in connection with the electric lighting of the baths. The highest tender in this case was hundreds of pounds above his.

Plaintiff said, in reply to the Bench, that his salary of £2 a week was not dependant upon anything.

After further hearing, Judge Emden said defendant had not made out a case for summary dismissal. He gave judgement for £2, being one week's wages in lieu of notice.

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### Knight *v.* The Isle of Wight Electric Light and Power Co.

In the Chancery Division of the High Court of Justice on Friday (April 15th), before Mr. Justice Joyce, Mr. Hughes, K.C., said that in this case he had a motion to sequestrate the company for committing a breach of the injunction his Lordship granted in January last restraining the company from committing any nuisance. As the affidavits were not complete, he asked that the motion might stand over for a week.

Mr. Younger, K.C., who appeared for the defendant company, said he was not sure that his evidence would be ready in a week.

Mr. Justice Joyce thereupon directed the motion to stand over until Friday, the 29th inst.

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### Employers' Liability Act.

At the Brompton County Court on Monday, before Judge Stonor and a jury, Ernest G. S. Burr, a fitter's mate, 20, Limerston Street, Fulham Road, Chelsea, S.W., brought an action under the Employers' Liability Act against the Underground Electric Railways Co. of London, Ltd., Hamilton House, Victoria Embankment, S.W., claiming damages in respect of personal injuries alleged to have been sustained owing to negligence on the part of the defendants or their servants. The claim was set down at £261 6s.

Mr. Wildey Wright appeared for the plaintiff, and Mr. Scarlett for the defendants.

Plaintiff's counsel stated that on January 4th last his client was in the employ of the defendants, working at the new generating station at Lot's Road. The man was told by the foreman on the job to assist in unhooking and lowering a heavy block and fall which was suspended from an iron girder. The men had to stand upon two 9-in. boards, and, it would be contended, no proper appliance was provided for releasing the tackle. The men had to raise the whole weight by their hands, while another man, by means of a rope turned twice round one of the girders, pulled in the "slack." Suddenly, however, the rope slipped, and plaintiff's left hand was caught and terribly crushed by the chain as the falling weight made it taut. The plaintiff bore out counsel's statement, and other witnesses corroborated.

Mr. William Robert Pether, civil and consulting engineer, maintained that the block and fall on the occasion in question was lowered in an unsafe way. They should have been raised and then lowered by means of a rope slung over something above, so that the men did not have the whole weight on their hands.

Mr. Edgar Shaw, engineer, agreed with the last witness.

For the defence, Richard Shimming, 15, Barclay Road, Fulham, foreman on the job, said that they had lowered blocks and falls both before and since, in just the same way as was done when the accident occurred. Witness had had considerable experience in the trade, and never knew of any method being adopted for lowering tackle other than that used at the time of the accident. After the accident, the plaintiff had admitted that it was due to his own fault.

Other evidence having been given,

Mr. Charles Frederick Fuller, Member of the Institution of Mechanical Engineers, maintained that the method adopted by the defendants on the occasion of the accident was a safe and proper one.

The jury found that the plaintiff met with his injuries through a "pure accident."

This was a verdict for the defendants, in whose favour his Honour gave judgement, with costs.

The plaintiff still had a claim under the Workmen's Compensation Act, and was awarded 16s.—half the amount of his usual wages—as from a fortnight after the accident till the present time, and as he was now partially incapacitated, 10s. a week from this date, so long as he was prevented by the effects of the accident from doing his ordinary work.

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### National Electric Traction Co., Ltd.

Sitting for the disposal of companies' business in the High Court of Justice on Tuesday, Mr. Justice Buckley had before him for hearing a petition by W. G. Skipworth for the winding up of the National Electric Traction Co., Ltd.

Counsel stated that it was a judgment creditor's petition, but the debt had been satisfied, and he asked that the petition be dismissed.

His Lordship assented.

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### National Electric Wiring Co. *v.* Miller.

This case came before a Divisional Court of King's Bench, composed of the Lord Chief Justice and Justices Wills and Kennedy, on Monday and Tuesday last, on the plaintiffs' appeal from a decision of his Honour Judge Smyley, sitting at the Shoreditch County Court.

Mr. Bailhache, for the appellants, said that the case arose under an electric lighting contract which had been before the Courts several times, although the point raised in the case had not arisen before. The action was brought by the plaintiff company for the wrongful removal of a free wiring installation which the plaintiffs, a free wiring company, had put in a house, of which the defendant was the landlord, the installation being put in at the request of a former tenant. The short facts were as follows:—In November, 1901, the plaintiffs put in an electric installation to a house in the occupation of a gentleman named Vousden, at Stoke Newington.

The Lord Chief Justice: What sort of a tenant was he?

Mr. Bailhache replied that he was evidently a tenant for a short term. In May, 1902, the plaintiffs discovered that their installation had been completely removed, and that Mr. Vousden had left. The company's agreement was made with Vousden. At the foot of the agreement was a memorandum signed by the landlord, or for the landlord, the defendant. The memorandum, upon the construction of which the case turned, was in the following terms:—"I, the undersigned, being the landlord of the above-named consumer, and being the owner of the premises, hereby consent to the installation of wires and fittings in the said premises upon the terms and conditions of the above agreement, and agree that the said wires and fittings shall not be removed without the consent of the Council and Wiring Co. in writing." The fittings were removed by the tenant who succeeded Vousden, and the plaintiffs were suing the defendant, the landlord, for breach of his agreement with the company. These agreements were always subsidiary to what were called the "head agreements." The municipality, or company, procured a provisional order to supply electricity for a certain district, and they in many cases entered into agreements with a free-wiring company to put in the installations into the houses in the district upon the terms in the agreements, and to be embodied in the agreements with the consumer.

The Lord Chief Justice: Is it agreed that the defendant, the landlord, is bound by the memorandum?

Mr. Bailhache: That is the point. The County Court Judge says he is not.

The Lord Chief Justice: On what ground?

Mr. Bailhache: He decided that the memorandum was a licence, and not an agreement at all. A point was taken in the Court below of the power of the son to sign the agreement on his father's behalf, but that point was effectually disposed of in the admissions in the County Court. This agreement was made between the three parties, the supply company, the Metropolitan Borough of Hackney, the wiring company, and the consumer. The scope of the agreement was that the wiring company put in the installation free of any initial expense, and the consumer had the option of buying the installation, and until he bought, so long as he used the installation, he paid a rent for it, that rent being collected by the supply company, the lighting company. It had been held in this Court that the word "used" in that connection meant "opportunity to use," and so long as he had an opportunity of using it. Appellants' position was this: As against the original consumer, so long as the installation is *in situ*, we are entitled to our rent for the opportunity of user; but, if that installation has been removed, then it is open to the consumer, so long as he has not himself removed it, or authorised the removal, to say "I shall no longer pay you any rent, because I do not, in fact, use the installation, and my opportunity to use it has gone." One other formality he would like to mention was that, on the strength of agreements of this kind, many thousands of pounds were invested in these installations, so it was important to have it decided exactly what the landlord's liability under these agreements was. The amount involved in this case was small—about £3 4s.

The Lord Chief Justice: I assume that Miller was not a party to the pulling down?

Mr. Bailhache: Oh, no.

The Lord Chief Justice: You say that the words "agree that the said wires and fittings shall not be removed," means that he undertook that they should not be removed. The question seems to be whether those words mean that the defendant undertook they should not be removed. What do you contend the promise is?

Mr. Bailhache contended that the promise was an undertaking by the defendant that the installation should not be removed. Of course, some limitation must be put on the matter. If a burglar

broke in and stole the fittings, of course the landlord would not be liable for that. His contention was that this was an undertaking by the defendant that the fittings, &c., should not be removed by his tenants.

Mr. Justice Wells: I should think that as soon as this discussion becomes known, you will get no landlord to sign the agreement in future.

Mr. Bailhache: What the plaintiffs wanted was to be protected against the very thing which had happened in the present case. The only person who could protect was the landlord, and that landlord had made an agreement to do so with the Wiring Co. There was nothing in the world to prevent him making a similar agreement with the new tenant that he himself let in. In the present case the defendant had not protected the plaintiffs at all. If the defendant did not mean to undertake an obligation of this kind why did he not put into the agreement submitted to him that the wires and fittings should not be removed by him or without his consent.

The Lord Chief Justice said that was the strongest way the learned counsel could put his case.

Mr. Eldon Bankes, having argued in support of the County Court Judge's decision on the point of construction,

The Lord Chief Justice, in giving judgement, said he never desired to send a case back, but it was practically impossible for them to give a satisfactory judgement in the present case without the facts being further stated, especially in view of the agreement that there was a contract in the present case. A good deal might turn upon what the actual position of the landlord was. All he said was, that it was impossible for the Court to say that this was a licence only. He agreed with Mr. Bailhache's argument that the words "agree, &c.," did impart a contract of some kind or other, but he thought a very grave question would arise as to the contract itself. There would also be some question as to the agency of the person who signed the agreement for the landlord. He thought that before the Court attempted to say what the rights of the parties were, the case must go back for further investigation, and must come up again on an agreed state of facts. The costs of the appeal, as well as the costs of the trial, to abide the result of the second trial.

Justices Wells and Kennedy concurred.

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### The Underground Electric Railway Co. of London, Ltd., and the Commissioners of Inland Revenue.

This case came before Mr. Justice Channell in the King's Bench Division on Tuesday. It was a special case, raising the question of the amount of stamp duty payable by the Underground Electric Railways Co. of London under the agreement by which they acquired control of the Brompton and Piccadilly Circus Railway, the Charing Cross, Euston, and Hampstead Railway, the Great Northern and Strand Railway, and the Baker Street and Waterloo Railway.

Mr. Roskill, K.C., and Mr. Austin Carpmael appeared for the railway company, and the Solicitor-General and Mr. Rowlatt for the Commissioners of Inland Revenue.

It appeared that by an agreement, dated June 25th, 1902, with the Metropolitan District Electric Traction Co., Ltd., the new company, the Underground Electric Traction Co., Ltd., which had been formed with a capital of £5,000,000, agreed to purchase the whole of their undertaking. The capital of the new company was to be divided into 500,000 shares of £10 each. Part of the conditions for the sale were:—(1) That £500,000 should be paid in cash by the new company on completion of the purchase, together with interest at the rate of 5 per cent. per annum on £250,000; (2) The sum of £500,000 in shares; and (3) The profits in the new company available for dividend in respect of each year should be applied:—(*a*) In payment of a cumulative dividend at the rate of 5 per cent. per annum on the amount for the time being paid up on any shares issued by the new company; and (*b*) in payment to the Traction Co. or its assigns as a further part of the consideration for the sale of such a sum as should be equal to a dividend of 3 per cent. on the amount for the time being, paid up on such of the original ordinary share capital of 5 millions in the new company as should for the time being have been issued by the new company. On July 8th, 1902, an instrument was presented on behalf of the new company for the purpose of being stamped, and the Commissioners of Inland Revenue, in assessing the duty payable, computed the consideration for the property agreed to be sold as £1,947,584, which, after making certain deductions, was put at £1,527,358. The question was whether the Commissioners were right in including therein the sum of £780,000 under Clause 3 of the agreement. The Commissioners held that the sum contingently payable out of profits in each year under the sub-clause was "part of the consideration of the sale," and that so far as such sum was capable of ascertainment at the date of agreement, it was liable to *ad valorem* conveyance duty at the rate of 10 per cent.

The company, on the other hand, submitted that such sum was incapable of assignment, by reason of the remoteness of the contingency upon which the payment must be made.

His Lordship, in giving judgement, said it appeared to be a case in which the two parties took uncertainties into consideration; that was to say, double contingencies in respect of the dividend, which might be earned by the new company, as well as the amount which might be raised in shares up to a certain period. Taking everything into consideration, he could not come to the conclusion that the Crown were entitled to put their finger down at a certain date and say "There is so much due and payable here." Therefore he must give judgement for the appellants, the Underground Electric Railways Co. of London, Ltd., with costs.

A stay of execution was granted.

### Downer v. Clark.

At the Watford County Court on Monday, before his Honour Judge Sir Alfred Marten, K.C., the action, remitted from the High Court, of Downer v. Clarke came on for hearing. The plaintiff, Mr. Harold Downer, electrician, High Street, Watford, sought to recover from Mr. Robert Clark, of the Moorgate Engineering Works, £90 0s. 6d. for electric wiring done at the St. Pancras Receiving Homes. Mr. M. A. Robertson was for the plaintiff, and Mr. Beaumont Morice for the defendant. The plaintiff stated that he contracted to do the wiring for £108 in accordance with a specification. He adhered to the first part of the specification, but the latter part, dealing with a main cable, was useless, as it was not in accordance with the rules of the St. Pancras electrical authority. Mr. Clark, in his evidence, said that the 250 ft. of main cable which was in the specification had not been done by plaintiff, who had simply tapped mains laid in by the authorities to feed an electrical pump. The work he had not done had saved plaintiff £50. He had not supplied, as he contracted to do, steel conduit tubes, wood troughs, four junction boxes, asphalt, water tight covers and main cables from Leyton Road to the building. Expert evidence was given as to the cost of the length of main cables. His Honour, in giving judgement, said that no variations were to be made without a written order from the architect, and no such order was given. As defendant had paid £25, and there was £50 in Court, judgement would be for defendant, with costs, from the time of payment into Court.

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### Workmen's Compensation Appeal.

An appeal was heard in London last week from a decision of the judge of the Oldham County Court, holding that the widow of a bricklayer who was killed by lightning while working on some buildings in course of construction was entitled to recover compensation from the man's employers. Their Lordships dismissed the appeal with costs, holding that, in the position in which the deceased was on the scaffolding, his risk of being struck by lightning was abnormal, and that, therefore, his death was due to an accident arising out of his employment.

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## BUSINESS NOTES.

### Electrical Wares Exported.

**Week ending April 21st, 1903.**

| | |
|---|---|
| Adelaide | Value £274 |
| „ Teleg. mat. | 572 |
| Alexandria | 265 |
| „ Teleg. apparatus | 186 |
| Amsterdam | 352 |
| Auckland | 222 |
| „ Teleg. mat. | 127 |
| Bangkok | 368 |
| Bombay | 58 |
| Boulogne | 218 |
| Buenos Ayres | 4,060 |
| Calcutta | 1,902 |
| „ Teleg. mat. | 378 |
| Cape Town | 177 |
| Colombo | 579 |
| „ Teleg. mat. | 952 |
| Copenhagen | 1,038 |
| Delagoa Bay | 391 |
| Durban | 1,587 |
| „ Teleg. mat. | 1,707 |
| East London | 222 |
| Hong Kong | 19 |
| „ Teleg. mat. | 12 |
| Lyttleton | 10 |
| Madras | 272 |
| Melbourne | 660 |
| Montreal | 90 |
| New York | 330 |
| Otago | 128 |
| Penang | 10 |
| Perth | 189 |
| Port Elizabeth Teleg. mat. | 238 |
| Port Said | 42 |
| Rangoon | 56 |
| Rotterdam | 136 |
| St. Helena. Teleg. mat. | 24 |
| San Sebastian | 21 |
| Shanghai | 789 |
| Singapore | 79 |
| „ Teleg. mat. | 739 |
| Stockholm. Teleg. mat. | 40 |
| Sydney | 229 |
| Yokohama | 18 |
| Total | £19,801 |

**Week ending April 19th, 1904.**

| | |
|---|---|
| Adelaide | Value £30 |
| Alexandria | 175 |
| „ Teleg. mat. | 441 |
| Amsterdam | 50 |
| Auckland | 20 |
| Bangkok | 35 |
| Bombay | 2,286 |
| Buenos Ayres. Teleg. mat. | 202 |
| Calcutta | 724 |
| Cape Town | 1,104 |
| „ Teleg. mat. | 175 |
| Colombo | 94 |
| Copenhagen. Teleg. mat. | 205 |
| Durban | 1,047 |
| „ Teleg. mat. | 903 |
| East London | 365 |
| Flushing | 51 |
| Fremantle. Elec. machinery | 102 |
| Genoa | 100 |
| Gibraltar | 41 |
| Hamburg | 20 |
| „ Teleg. mat. | 135 |
| Hobart | 79 |
| Launceston | 56 |
| Lisbon | 65 |
| „ Teleg. instruments | 30 |
| Madras | 67 |
| „ Elec. tramway mat. | 150 |
| Melbourne | 30 |
| Oporto | 858 |
| Otago | 62 |
| „ Teleph. cable | 843 |
| Paris | 377 |
| „ Elec. machinery | 1,340 |
| Pernambuco | 126 |
| „ 620 cwt. teleg. wire | — |
| Perth | 574 |
| Port Elizabeth | 694 |
| Rosario. Teleg. mat. | 141 |
| Rotterdam | 57 |
| Saigon | 150 |
| Santos | 660 |
| Seychelles. Teleg. mat. | 26 |
| Shanghai | 81 |
| „ Teleg. cable | 1,700 |
| Singapore | 281 |
| Stockholm. Teleg. cable | 380 |
| Suez. Teleg. mat. | 225 |
| Sydney | 1,075 |
| Vigo. Teleg. paper | 165 |
| Wellington | 93 |
| Yokohama | 1,647 |
| Total | £20,337 |

### Foreign Goods Transhipped.

| | |
|---|---|
| Otago. Elec. mat. | Value £270 |
| Cape Town. Elec. mat. | Value £40 |
| Durban. Elec. goods | 1,934 |
| Melbourne. Elec. apparatus | 52 |
| Total | £2,026 |

**Fire.**—On the 13th inst. a fire broke out in an electric fittings store on the premises of Messrs. White Bros., electrical engineers, Sunderland.

**Horsfall Destructors.**—The Horsfall Destructor Co., Ltd., of Leeds, have lately brought out new issues of their Nos. 1 and 2 destructor lists. No. 1 gives outline particulars of a large number of plants which had been put down by the company for public authorities in this country and abroad, with photographic illustrations, and a few details respecting the chief undertakings. A number of the plants put down to work in conjunction with electricity supply works are included. List No. 2 is a collection of reports upon the results obtained with Horsfall installations, and we believe it will be of service to electrical engineers and other officials who wish to know the value of destructors when combined with electric generating plants.

A few weeks ago the question of employing a Horsfall destructor at Dodworth, on property of the Windsor Corporation, at a cost of £6,000, was the subject of a Local Government inquiry. The town clerk said that the Corporation had adopted the Horsfall type because it was so constructed as to cause no nuisance. Mr. George Watson, managing director of the Horsfall Co., stated that the chimney would be 90 ft. high, that all fumes would be cremated, and that they would guarantee that there would be no nuisance whatever from the destructor and would take full responsibility. Special precautions had been taken to catch the dust, a centrifugal dust-catcher being fixed, so as to prevent the escape of any dust from the chimney; 65 of these destructors were at work all over the country, and there had been no complaint against any of them. There would be no bad smell or nuisance of any description. Dr. C. J. Jackson, medical officer of health for Fulham, stated that a Horsfall destructor had been in operation at Fulham for five years, burning 35,000 tons of refuse per year. It was situated on the river bank, and within 120 yards of a dense mass of houses. The population of Fulham was 150,000, and he had never had a single complaint of nuisance from the destructor. He visited, on behalf of his board, some eight or ten destructors in different parts of the country before he recommended the Horsfall.

**Book Notices.**—"Subject-Matter Index of Mining, Mechanical, and Metallurgical Literature for the Year 1901." Edited by M. Walton Brown. Newcastle-upon-Tyne: North of England Institute of Mining and Mechanical Engineers. Price 42s.

"La Théorie de Maxwell et les Oscillations Hertziennes—La Télégraphie Sans Fil," by H. Poincaré. Paris: C. Naud.

"The Electrical Industry: Lighting, Traction, and Power," by A. G. Whyte. London: Methuen & Co. 2s. 6d. net.

"Practical Slide Making" (Photography Bookshelf Series), by G. T. Harris. London: Iliffe & Sons, Ltd. 1s. net.

"The Income-tax Burden," by T. Hallett Fry. London: Horace Cox. The *Law Times*. 6d.

*The City of London Directory*, 1904. London: W. H. and L. Collingridge. 12s. 6d. This directory, which is essentially a work for use in City offices, has now reached its 34th year. Its contents hardly lend themselves to a review; a mere recital of the sectional titles will serve to indicate the nature of the contents; there are, of course, the indispensable street, alphabetical and trades sections, and there are also departments devoted expressly to official matter, biographical notices, and particulars of public companies. The coloured map of streets is serviceable. The book is substantially bound, and has a good office-shelf appearance, but we cannot vouch for the accuracy of the whole of the directory matter, for no record of City of London addresses can be considered complete which fails to include the name of the Electrical Review, which has been published in London for the past 32 years.

*The Citizen's National Union*. Paisley: Alex. Gardner. 6d. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. This is an interesting pamphlet written by Mr. John Tullis, of St. Ann's Leather Works, Glasgow, bringing up to date another pamphlet written by the same author 12 years ago. The subject matter revises and brings into line with the fiscal question of to-day, the old age pension scheme formulated in 1892 as the Citizens' National Union. Mr. Tullis contends that the Poor Laws, as at present administered, have served their day, and that the time has come for the whole question to be fully considered in all its aspects, and the recent controversy respecting tariff reform has induced him to publish this new edition. The writer has produced an interesting contribution to the literature of a momentous problem, and although the subject is not within the immediate scope of the Electrical Review, and is not one for criticism from our pen here, we may go so far as to say that we believe that it might profitably be studied by many of our readers, if only to stimulate interest in, and discussion of, the matter.

*The Tyneside Electrical Pioneer*, No. 1.—We have received from the Newcastle-upon-Tyne Electrical Supply Co., Ltd., a copy of a periodical about to be published by that company for the purpose of advertising the advantages of electric light and power in the Newcastle area. The company is undoubtedly moving in the right direction, and Tynesiders will be attracted by the bright cover, if not by the rather feeble and, luckily, brief contents of this first attempt.

**Tenth Anniversary.**—On the 18th inst. the Private Wire and Telephone Installation Co., Ltd., of 5, Palmer Street, Westminster, S.W., celebrated the tenth anniversary of its establishment. This firm, which has made a special feature of electric installations in asylums, hospitals, and public buildings, has carried out important contracts in various parts of the country. The company during the last few years has also undertaken electric light work, and the increase in this direction has been so great as to necessitate the creation of a separate department, which has been placed under the management of Mr. H. Bevan Swift, late of Messrs. Ball Bros. & Bates, who has recently joined the firm.

**Catalogues and Lists.**—The Electrical Co., Ltd., of Charing Cross Road, W.C., have issued a handy file for keeping their various lists together in a convenient manner for easy reference. The lists already filed deal respectively with incandescent lamps, Nernst lamps, Luna arc and flame lamps, E.C. electric fans and ventilators, electric light fittings, and a 32 pp. booklet relating to meter-testing. This last-mentioned list has only just been issued from the press, and it describes the company's various apparatus for calibrating electricity meters, and gives useful directions, formulæ, and particulars of the different types of meter supplied by the company.

An illustrated sheet showing and describing Patschke's drawing apparatus for engineers has been sent to us. All parts of the apparatus are movable, so that the draughtsman can work either sitting or standing. We understand that although the equipment has only been on the market a short time, it has already been adopted by many well-known colleges and engineering concerns on the Continent, and it is employed by the British Westinghouse Co. and a number of large manufacturing firms in this country. The sole agent for Great Britain and the Colonies is Mr. Ernest C. Koop, 42—44, Moor Lane, Fore Street, E.C.

The Klein Engineering Co., Ltd., of Manchester, has issued a new catalogue, describing its condensing and water-cooling plant for electric light and power stations and other conditions of service, including special plant for steam turbines and high vacuum. There are some good half-tone pictures, and many drawings showing the different plants.

The latest lists issued by the British Thomson-Houston Co., Ltd., are: No. 165, relating to open arc lamps; and No. 166, showing their electro-magnetic track brakes.

A four-page list (No. 105) received from Messrs. Siemens Bros. and Co., Ltd., touches upon telpherage in works and factories, and its illustrations show a system in operation at the company's works at Woolwich.

From the British Prism Globe Electrical Co., Ltd., of 145, Norfolk Street, Sheffield, there has come to hand an 18-page catalogue, showing the many different designs of street lighting fittings, to which their Prism globes are applicable.

A small circular (No. 15) has been issued by the Bath Electric Manufacturing Co., Ltd., describing briefly their "Kramos" resistance-piece.

We have received from the Allgemeine Elektricitats Gesellschaft and the Union E.-G., of Berlin, a pamphlet illustrating the application of their electric motors to the driving of rolling mills, dealing with iron and steel, copper and other metals, and including a list of contracts of this description which they have carried out. Another pamphlet from the same source describes the oil-cooled transformers, of more than 50 kw., made by the A.E.-G., with numerous illustrations and curves. The outputs listed range up to 500 kw., and the primary pressures to 30,000 volts. A similar pamphlet relates to the use of electricity in weaving mills, showing various methods of applying the motors, which all appear to be of the polyphase type. No fewer than 8,640 motors have been installed for this purpose by the A.E.-G.

The Private Wire and Telephone Installation Co., Ltd., of Westminster, have issued new lists detailing their "Housephone" and "Kitchenphone" for electric bell circuits, "Ever-ready" electric lighting specialities, and their patent automatic intercommunication telephones.

Messrs. Turner & Hudson, Ltd., of Ivy Street, Hoxton, have issued a list of revised prices for 1904 for whitewood electric wire casings and covers.

The Siemens Electric Appliances, Ltd., of Watling Street, E.C., have placed upon the market a new ammeter for both direct and alternating currents, for testing incandescent lamps up to 32-c.p. and 250 volts. Lists will be sent on application.

Messrs. Johnson & Phillips have sent us several handsome half-tone reproductions of important installations which they have carried out, including Barnsley, Blackheath and Greenwich, and Southwark central stations.

Messrs. W. N. Brunton & Son, of Musselburgh, have brought out a new edition of their resistance material catalogue. This is the third edition of the list. A considerable amount of new data have been added respecting new specialities which they are now manufacturing for the electrical trade, as well as resistance material, such as cable clips, arc lamp rope, &c. The tables of resistance, carrying capacity, &c., of the "Beacon" high resistance wire have all been revised.

**The German Electrical Machinery Trade.**—There was an increase last year in the exportation of electrical machinery from Germany, the shipments attaining a total of 13,576 tons, valued at £1,086,050, as contrasted with 13,450 tons and £1,076,000 respectively in the preceding year. The quantities taken by the different countries are shown in the appended table, the figures for 1902 being added to enable a comparison to be made:—

| | 1903. Tons. | 1902. Tons. | | 1903. Tons. | 1902. Tons. |
|---|---|---|---|---|---|
| Great Britain .. .. | 3,620 | 4,667 | Denmark .. .. | 200 | 317 |
| Russia .. .. .. | 1,234 | 1,406 | Mexico .. .. .. | 179 | 178 |
| Belgium .. .. .. | 1,231 | 972 | Japan .. .. .. | 178 | 132 |
| Italy .. .. .. | 1,089 | 1,076 | Australia .. .. | 133 | 69 |
| Spain .. .. .. | 916 | 837 | Finland .. .. .. | 130 | 138 |
| Holland .. .. .. | 781 | 417 | Transvaal .. .. | 128 | 93 |
| Austria and Hungary .. | 571 | 548 | Chili .. .. .. | 124 | 112 |
| Sweden .. .. .. | 497 | 430 | British East Indies .. | 75 | 5 |
| Argentina .. .. | 480 | 407 | Brazil .. .. .. | 61 | 80 |
| Switzerland .. .. | 370 | 285 | Roumania .. .. | 52 | 106 |
| France .. .. .. | 315 | 240 | Other countries .. | 980 | 674 |
| Norway .. .. .. | 292 | 261 | | | |

It will be seen that while Great Britain is still Germany's best customer for electrical machinery, last year's total shows a marked decline on that for 1902.

**Bankruptcy Proceedings.**—A receiving order has been made against C. M. Downie, electrical engineer, of 4, Bloomsbury Street, E.C., and Crouch Hill.

A receiving order has been made on debtor's own petition against C. Aubrey Smith, trading as C. J. Smith, electrician, King Street, Regent Street, and Wandsworth Common. The first meeting and public examination are to take place at Carey Street on April 28th and May 31st respectively.

At Preston Bankruptcy Court on Friday, Gavin Knox Gilchrist, electrical engineer, of St. Annes-on-Sea, was publicly examined. The accounts showed secured liabilities amounting to £184 14s. 4d.; fully secured liabilities, £4,711; assets, £75 10s., and a deficiency of £109 4s. 4d. Debtor commenced business at St. Annes and Manchester in 1900, under the style of Gilchrist & Co. He subsequently sold the business to a Manchester firm for 2,500 fully-paid £1 shares in their concern. These shares were allotted to his grandmother, who had lent him money, and the company had since gone into voluntary liquidation. The examination was adjourned until May 6th.

**Dissolutions and Liquidations.**—The Argentina Electric Traction Co. is winding up voluntarily with Mr. Alfred Clements, 83, Cannon Street, E.C., as liquidator.

Steam Generators, Ltd., is winding up voluntarily with Mr. S. Peck, Hamilton House, Victoria Embankment, E.C., as liquidator. Creditors must send particulars of debts, &c., to Mr. Peck, by May 2nd.

Creditors of the British Electric Separating Co., Ltd., must send particulars of their debts, &c., to Mr. R. P. Pike, 35/36, Wind Street, Swansea, the liquidator, by May 31st.

A meeting of the Yorkshire Electric Power Syndicate is to be held on May 17th, at Leeds, to hear an account of the winding up.

Creditors under a deed of assignment executed in 1902 by R. Colston, of Paddington, must send particulars of their claims to the trustee (see advertisement announcement) by May 5th.

First meetings of creditors and contributories of the Electric Timber Seasoning and Preservation Co. (65/66, Chancery Lane, E.C.), are to be held on April 29th, at 33, Carey Street, W.C.

A petition for winding up the National Electric Traction Co., Ltd., is to be heard in London on May 3rd.

The Horsfall Furnace Syndicate is winding up voluntarily, with Mr. C. F. Dent, of Lord Street Works, Leeds, as liquidator. A meeting is to be held on May 26th to show how the winding up has been carried out. Our readers will note that this is not the Horsfall Destructor Co., Ltd.

Creditors of Heaton & Smith, Ltd., must send particulars of their debts, &c., to the liquidator (Mr. J. P. Garnett, 22, Booth Street, Manchester) by May 7th.

Messrs. H. Thorpe and H. J. Salter (Thorpe & Salter, electrical and mechanical engineers, High Holborn, W.C., and Holloway), have dissolved partnership.

**Trade Announcements.**—Mr. Harry Snowdon, the sole manufacturer of the Nodon patent electric valve in this country, has removed from 52, Queen Victoria Street, to larger offices at Balfour House, Finsbury Pavement, E.C.

Messrs. Thomas Noakes & Sons, of 4—5, Osborn Place, Brick Lane, E., are manufacturers and sole licencees of Hewer's patent section insulators, which, we understand, are being used by the Metropolitan Electric Tramways Co., the London United Tramways Co., the B.E.T. Co., and others.

The New Brotherton Tube Co., Ltd., have moved their Glasgow agency, and have now opened offices and stores at 3, Cadogan Street, Glasgow, to which address all communications for that district should be sent.

Messrs. C. Olivetti & Co., the well-known electrical instrument makers in Italy, are removing their works from Ivrea to Milan, where they will have ample facilities for coping with future business extensions. The staff of the firm will be the same as hitherto, and the indulgence of customers is asked while the removal process is in progress. The new address is Via Broggi, 4, Milan.

Mr. G. Braulik announces that he has been appointed sole agent in this country for the Regina long-burning enclosed arc lamps, which are claimed to burn for 200 hours with one set of carbons.

The A.E.G. Electrical Co. of South Africa, Ltd., of 125, Charing Cross Road, W.C., has been formed to carry out electrical and general engineering business in South Africa, and has acquired the large South African business of the Allgemeine Elektricitäts Gesellschaft, of Berlin. The business will cover all branches of electrical engineering, including town supply, tramways, light railways, harbours, mines and factories, and the furnishing of electrical supplies, such as cables, arc lamps, incandescent lamps, switches, fuses, &c. A special department has been created for electrical mining work. The company has established its chief South African office at Johannesburg, and announces that it will shortly be represented in all the important towns of South Africa. The registered offices of the company in London are at 125, Charing Cross Road, W.C.

Mr. W. Gyllich, late of 10, Lloyd's Avenue, E.C., has removed to 90, Great Russell Street, W.C., at which address he will in future conduct his business under the new title of the Titan Lift and Electric Co.

**Electrical Machinery Imports.**—Returns just issued show that the value of the foreign electrical machinery imported into this country during March amounted to only £43,432, as contrasted with £48,967 in the preceding month, and £56,470 in March, 1902. For the first three months of the current year the value of these imports has only reached a total of £139,336, or £44,935 less than in the corresponding quarter of 1902.

**Electricity in the Printing Trade.**—We have received an advance copy of a supplement to the forthcoming issue of *Everyday Electricity*, consisting of an illustrated article by Mr. W. A. Clatworthy on the subject named above. The article is of a technical character, and explains in lucid terms the requirements to be met and the chief methods of meeting them.

**Nernst Lamps.**—We have received from the Electrical Co., Ltd., of 125, Charing Cross Road, W.C., some interesting particulars bearing on the question of street lighting by means of the Nernst lamp. The district of Dartford some time ago adopted the Nernst lamp for all its street lighting work, and at the present time, with some 200 of these lamps in use, renewals average 15s. per week. During the 12 months ending December 31st last, renewals on 188 posts cost 8s. per post, including some special expenditure. If ordinary incandescent electric lamps (two 16-c.p. per post) had been in use, their renewals, allowing 500 hours' life, would have amounted to 11s. 8d. per post per annum of 3,500 hours, the Dartford lighting hours per annum amounting to 3,870. The engineer to the Dartford U.D.C. has made numerous life tests on Nernst lamps, and in January, 1903, the average life of 11 1-ampere burners so tested amounted to some 400 hours per burner; the average life of 19 ½-ampere burners amounted to 380 hours per burner. More recently specimens of ½ and ¼-ampere burners have run 1,700, 1,300, 1,500, 1,400 hours, only one of these not being in working order when brought in. These results are indicative of the improvements which are being effected in the life of these lamps and which should lead to their wider adoption in fields for which they are so well adapted. The same firm also send us particulars of a patent automatic cut-off switch, which is suited for installing with lamps for shop window lighting or other work. The switch is combined with an ordinary alarm clock, which can be set to switch out the lights at any desired time in the evening.

**Wiring Contracts.**—The wiring of the Gloucester General Infirmary (Simplex), and the new Methodist Church, has been secured by Messrs. Parsons Bros., Gloucester, who have in hand also arc and incandescent lighting at the new tramway dépôt, Gloucester, and the incandescent lighting of the Bridge Iron Works, Chepstow, Mon.

Messrs. A. G. Arnold & Co., of Newport, are carrying out an electric light installation in the Parish Church and Vicarage at Minehead (Som.).

**Motor-Generators for Johannesburg.**—Messrs. Mather and Platt, Ltd., of Manchester, have just received the order for two exactly similar sets of motor-generators, and for a third pair of dynamos, all being for use in connection with the Johannesburg Electricity Works. Each motor-generator set consists of a 250-kw. two-phase alternator for a current at 3,300 volts and a frequency of 50 cycles coupled to a pair of continuous current dynamos, each of 150-kw. capacity at pressures varying from 230 to 275 volts. In the first instance it is intended to drive each set direct from an Allen steam engine, provision being made for disconnecting the continuous current dynamos from the alternator if desired. At a later period the engine will be removed altogether, and then current from the tramway or lighting mains being supplied to the continuous current dynamos in series, these will act as motors, and drive the alternator attached to them; or two-phase current being supplied to the alternator, the pair of continuous current dynamos driven by it will be used, either in series for supplying current to the tramways, or as balancers on the three-wire lighting system. The extra pair of continuous current dynamos will be precisely similar to those above described, and will be used as balancers on the three-wire system.

**Willans Engine Contracts.**—Messrs. Bruce Peebles and Co., Ltd., have sublet to Messrs. Willans & Robinson, Ltd., the order for two 750-kw. engines for direct coupling to Peebles alternators for the Pumpherston Oil Works, Scotland.

The British Westinghouse Electric Manufacturing Co., Ltd., have sublet to Messrs. Willans & Robinson, Ltd., the order for one 750-kw. engine for direct coupling to a Westinghouse dynamo for the Aberdeen Corporation.

**Private Telephone Installations.**—We understand that the National Telephone Co. is at present introducing an elaborate telephonic installation, consisting of something like 200 telephones, at the Savoy Hotel. It will be worked on the common battery system. The installation includes a 440-line switchboard. The majority of the private apartments will have access to both the Post Office and the National Telephone services. The instruments are of the Ericsson type.

The National Co.'s contract department has also lately put in an installation for the National Mutual Assurance Co., 39, King Street, Cheapside; it is a 15-line inter-communication installation with automatic replacing instruments, bringing any department into communication with others at a moment's notice.

**For Sale.**—The property, plant and machinery of the Dessolle Electro-plating Co., Ltd., of Birmingham, are to be offered for sale by auction on April 27th by Messrs. Edwards, Son & Bigwood. Particulars are given among our advertisements to-day.

The Dundee T.C. invites offers for 3,000 100-volt incandescent lamps, 46 arc lamps, and seven motors. See our advertisement pages to-day.

**Electric Driving.**—Messrs. Johnson & Phillips, of Old Charlton, Kent, have sent us a handbook entitled "The Application of Electric Motors to Machine Driving" (a special edition of Mr. Andrew Stewart's little book, which was published by Messrs.

Rentell & Co., Ltd.), and we understand that a copy will be forwarded to those contemplating the introduction of electric driving in works, especially the iron and metal, textile, and printing trades.

## LIGHTING AND POWER NOTES.

**Ashton-under-Lyne.**—The T.C. has reduced the price of energy to places of worship from 4d. per unit to 2½d.

**Barking.**—The U.D.C. has decided to abolish meter rents for electric lighting.

**Bispham.**—The U.D.C. has appointed a Committee to consider the adoption of electric light for its district.

**Bradford.**—Commencing from July 1st next, the Corporation has resolved to reduce the price of energy for lighting purposes to 4d. per unit, and to abolish meter rents.

**Bridgwater.**—Work was commenced last week on the erection of the Bridgwater and District Electric Supply and Traction Co.'s generating station, which will, when completed, supply the town with electricity for public and private lighting.

**Buenos Ayres.**—The Government has signed a contract with the German Electric Light Co. for the supply of energy for five years at 9 cents gold per unit for lighting and power, and 5½ cents gold for decoration lights.

**Dalkeith.**—In connection with the Council's decision not to give an undertaking that the street lamps should be lighted for a certain minimum number of hours each year, Messrs. Crompton and Co., who are introducing the E.L. into the town, state that unless the T.C. is prepared to concede what they ask, arbitration proceedings will be taken. The company have lowered the number of hours to 3,000 per annum as the minimum, but the Council has agreed that it would not be correct to give the guarantee asked for.

**Darlington.**—A sub-committee has been formed by the T.C. for the purpose of considering the desirability of adopting a free wiring scheme, and supplying motors to consumers.

**Dublin.**—The Corporation has formally rejected the engines installed in the Pigeon House station, and has entered into a formal agreement with the General Electric Co. for replacing or renewing the defective machinery.

**Dunfermline.**—The T.C. has requested Mr. J. A. Bell, of Aberdeen, to give his services as expert adviser to the Corporation in the proposed introduction of the electric light into the burgh. It is stated that the Aberdeen Corporation has agreed to allow Mr. Bell to advise the Corporation, and Mr. Bell himself has written stating that he is willing to act for the burgh.

**Elland.**—A L.G.B. inquiry was held on 13th inst. into the application of the U.D.C. for powers to borrow £4,000 for extending its E.L. mains, &c. The Elland-cum-Greetland Gas Co. opposed the extensions.

**Germany.**—A municipal electric light station is about to be put down at Heidenheim.

**Glasgow.**—The inquiry into the application by the Clyde Valley Electrical Power Co. for lighting orders for Vale of Leven, Alexandria, Shettleston and Bothwell has been postponed.

**Golborne.**—The Lancashire Electric Power Co. has asked the U.D.C. whether it would be willing to take a supply of energy in bulk for lighting and power purposes, or allow the company to supply direct. In the latter case, the company would be willing to pay a royalty on the amount purchased.

**Gosport.**—The B. of T. has informed the U.D.C. that, unless the Council takes some definite action, the E.L. order will be revoked. The Council has replied that it is taking active measures to carry out the order.

**Grays.**—The U.D.C. has decided to offer consumers the option of 7d. and 3d. maximum demand, instead of 7d. and 4d., or a uniform rate of 5d. per unit.

**Hetton-le-Hole.**—In regard to the application to the B. of T. of the Houghton-le-Spring Electrical Co., which is seeking lighting powers for the district, for leave to dispense with the Council's consent, the B. of T. has suggested a meeting of the representatives of the company and the Council in London, but the Council has declined to send representatives, and still withholds its consent to the order.

**Kendal.**—The result of the last year's working of the E.L. undertaking shows a deficiency of £423.

**London.**—METROPOLITAN ASYLUMS BOARD.—It was decided on 16th inst. to apply to the L.G.B. for sanction to incur an expenditure of £6,940 on wiring and fitting up the Eastern and Western Hospitals and ambulance stations for electric light. An estimate of £2,500 to provide electric light on the new training-ship to replace the *Exmouth* was passed.

CITY.—An arrangement has been entered into with the City of London Electric Lighting Co. to supply energy during the ensuing year, at 3d. per unit for light and 2d. for power, to the Guildhall, the Art Gallery, the Guildhall Justice Room, the new offices in Aldermanbury, the South Court, and 9 & 10, Tower Street. A proposal to undertake the re-wiring of the Corporation buildings, which is estimated to cost £200, is to be considered.

FULHAM.—The Lighting Committee of the B.C., in a report submitted on 18th inst., recommends that the additional machinery which it is proposed to install to meet next winter's requirements should be one 750-KW. Curtis turbine set, and that it be ordered at once, and fitted on temporary foundations at a total estimated cost of £7,000. The electrical engineer has also been instructed to prepare and lay before the Committee plans and particulars of a complete scheme of extension, which may be adopted and carried out from time to time as necessity arises.

LAMBETH.—At a recent meeting of the B.C., the failure of the electric light in the large hall at the Baths during a public entertainment was discussed. It was stated that the company's supply failed owing to the blowing of a fuse. The L.C.C., as a result of an inspection, has ordered that either an alternative light for the licensed portion of the building must be provided, or that the Council must undertake that its private plant—which was, however, connected up in a short time on the evening of the breakdown—must be kept running when the hall is in use for public entertainments, and that an electrician must be employed to attend to the plant, and that the building must be re-wired, for which the B.C. has placed a contract. The B.C. is considering the question of laying on gas as a secondary lighting supply, owing to the cost of running the private generating plant, which, it was stated, cost, exclusive of wages, 2s. 6d. per hour on a consumption of 10 units. The cost of supply by the company at 5½d. per unit was estimated at 4s. 4½d. per hour.

BERMONDSEY.—At the B.C. meeting on 19th inst. the Lighting Committee reported that on the 30th ult. the Council wrote to the Board of Trade, calling attention to the decision in the case of Colville and Others *v.* St. Pancras B.C. A reply was received, stating that "the question of promoting legislation to enable the Board to include in provisional orders made by them provisions for the compulsory acquisition of land for the purpose of electricity generating stations, is at present receiving the attention of the Department." It was resolved to send representatives to a conference of metropolitan and provincial local authorities and companies, convened by St. Pancras B.C., to petition the B. of T. to promote legislation so as to prevent actions similar to Colville *v.* St. Pancras Council being taken against undertakers unless serious damage or nuisance is occasioned, and in that event the undertakers should have the power of acquiring compulsorily the interests affected.

HAMMERSMITH.—In a report issued on 19th inst., the Lighting Committee of the B.C. stated it had received a long communication from the electrical engineer in regard to proposed extensions. He said, "My suggestion is to build an entirely new boiler house containing 12 boilers with economisers, forced draught apparatus, feed pumps, air and water heaters, &c. These boilers to be operated with forced hot-air draught, so that only a short and cheap chimney would be needed, and the boilers would deliver superheated steam into an engine room built at the north end of this boiler house and forming a continuation of the present engine room where the new generating machinery will be fixed. A further extension of the engine room would form the completed generating station so far as the present site would allow. This is upon the assumption that the turbine generating sets are found to be satisfactory, in which case this arrangement would enable machinery of a total capacity of 17,000-KW. to be installed. When completed, the present Nos. 2, 3 and 4 generating sets will not be required after next year, as they are not so economical as the larger sets, so the space occupied by these machines could be set apart as a H.T. switch room and distributing station with a specially designed switchboard, so that the danger of interrupted supply through fire or other causes would be reduced to a minimum. I consider it necessary to commence carrying out the following section at once:—This comprises two boilers capable of supplying a total of 40,000 lbs. of steam per hour with the necessary accessories. In order to avoid spending money on a new chimney stack, I would propose turning the gases into the present chimney until it is loaded up to its full capacity under forced draught. I estimate the probable cost of the immediate requirements as follows: two boilers, including accessories, brickwork, &c., £12,100; two steam turbines, £20,000; ash conveyor hopper, feed water reserve tank, battery, boosters, foundations, steel chimney, flues, extension of condensing main, &c., £5,900; contingencies, £2,000; total £40,000." The Committee has called for tenders for the plant immediately required. Further, the Committee reported that upon the recommendation of the electrical engineer, it had decided in favour of negotiations being opened for the supply of electricity in bulk to large consumers for power purposes upon the following terms:—(*a*) The supply to be given at a uniform rate of 1d. per unit both winter and summer for a minimum period of five years, upon the understanding that the whole of the consumers' power supply shall be taken from the Council, the minimum amount of energy to be consumed to be 200,000 units per annum, of which the consumption for lighting purposes must not exceed 10 per cent.; (*b*) in order to induce present consumers to continue increasing their demand for electricity for power purposes at the existing price of 1½d. per unit, to allow substantial discounts.

STOKE NEWINGTON.—The B.C. on 19th inst. agreed to pay Messrs. Talbot & Stevenson, consulting engineers, a fee of 50 guineas for advising upon electric lighting schemes, and a commission of 2½ per cent. for drawings, specifications, &c., and a further 2½ per cent.

on the capital outlay for supervising the work, subject to the condition that if further work is proceeded with half the fee of 50 guineas is to merge into any commission that may become payable.

Shoreditch.—On Tuesday the B.C. decided to purchase at an estimated cost of £340, a motor balancer for use at Coronet Street station, in connection with the three-wire system. It being deemed desirable to change the pressure of supply in Kingsland Road, an estimate of £300 for laying a third wire was passed.

**Leigh.**—The Tramways and Electricity Committee of the T.C. has resolved to communicate with the L.G.B., withdrawing for the present its application for sanction to borrow £8,030 for extensions at the electricity works.

**Londonderry.**—The electrical engineer has reported several cable breakdowns, and proposes that the public lamps be connected to the private circuits in view of such occurrences. The estimated cost of the alteration is £340, and the scheme if carried out would reduce the number of lamps affected to nine as against 49 at present.

**Louth.**—The prices for the supply of energy under the agreement recently entered into by the T.C. and the National Electric Construction Co. are: Private lighting, 6d. per unit; power, 3½d. and 2½d. maximum demand; street lighting, 2⅝d. per unit; public buildings, 4d.

**Newtown Stewart, N.B.**—The T.C. has decided to ascertain whether any public or private company will undertake the electric lighting of the burgh.

**Northwich.**—A meeting of the shareholders of the Northwich Electric Supply Co. has been summoned to authorise the transfer of the undertaking to the Cheshire Electricity and Power Gas Co. The suggested terms of transfer are the repayment of all capital invested in the company, with such a sum in addition as will bring the dividends up to 7½ per cent. per annum, and a further 5 per cent. on value.

**Osaka.**—Owing to fatalities having occurred, due, it is stated, to defective electric lighting apparatus in the streets, a Judge and Procurator, accompanied by Prof. Namba, of Kyoto University, recently visited the generating works of the Electric Light Co., and inspected the machinery.

**Preesall.**—Mr. Oswin Hansom, of Fleetwood, has placed before the U.D.C. a scheme for electric lighting. He suggests the formation of a local company, which could apply for a prov. order in June next. The Council has resolved to fully consider the scheme.

**St. Annes.**—The L.G.B. has assented to the U.D.C. raising a loan of £4,000 for E.L. mains, &c.

**Stockton Heath.**—The Warrington T.C. having been approached as to supplying energy to the parish, has informed the P.C. that Parliamentary powers would be required to enable it to give a supply; and, if the approval of the Council was obtained, the Corporation would promote a Bill. The P.C. has decided to obtain a copy of the Cheshire Electricity and Power Gas Bill before taking any action in the matter.

**Stourbridge.**—A L.G.B. inquiry was held on the 14th inst. relating to the application of the T.C. to borrow £16,000 to put down an E.L. plant, which it is proposed to erect adjoining the refuse destructor. There was some opposition, and it was stated that the Midland Electric Corporation mains were already laid to the town boundary. The clerk explained that the Midland Corporation declined to supply electricity in bulk when the question came before the Council, but it was stated in reply to a question by the Inspector that the Corporation had offered just recently to supply the Council. The Inspector expressed the opinion that the whole question should be again considered by the Council.

**Sydney (N.S.W.).**—The works in connection with the contract for the various services included in the City Council's scheme for the lighting of the city by electricity are progressing satisfactorily. It is anticipated, says the *Australian Electrical Record*, that the installation will be completed by contract time, and the opening will probably take place early in May. A month ago there were over 200 men employed in the work of laying the feeding cables. In the business centres double shifts were being worked so as to expedite matters.

**Watford.**—The B. of T. has granted a prov. order enabling the U.D.C. to extend its area of supply.

**West Bromwich.**—On the 14th inst., the L.G.B. held an inquiry into an application by the T.C. for sanction to borrow £2,998 for electrical purposes.

**Windsor.**—The T.C. has sealed a contract with the local Electrical Installation Co. for lighting the town by electricity.

## TRAMWAY AND RAILWAY NOTES.

**Bath.**—An electric car accident occurred at Bath on Tuesday evening. A car containing a dozen passengers is reported to have got out of control when going downhill, and left the rails. A newspaper reports that the car took a zigzag course for 50 yds., ploughed up the pavement, and crashed into a wall, doing considerable damage. The car was damaged, but none of the passengers were hurt.

**Glasgow.**—A further extension of the Corporation tramways from Carntyne to Parkhead Cross has been opened for traffic.

**Huddersfield.**—Major Druitt, Board of Trade inspector, has inspected the Corporation's tramway undertaking with which he expressed general satisfaction, especially with the rolling stock, the brakes, and the accommodation. He sanctioned an increase of speed equal to two miles per hour.

The revenue account of the tramways system shows an increase in the receipts of over £9,000, the total receipts for the year ended March 31st being £65,545, but there is a deficiency of nearly £5,000. The capital outlay on the undertaking up to date has been £411,390. The miles run have been 1,632,000, as against 1,321,929 in the previous year. The receipts per car-mile have averaged 9·63d., as compared with 10·28d. last year. This is accounted for probably by the reduction of fares. On the expenditure side, maintenance and repairs account for £9,888, which works out at 1·45d. per car-mile, as compared with 1·74d. in the previous year. The traffic cost is put down at £16,940, or at the rate of 2·49d. per car-mile, as against 2·75d. last year. Maintenance of works is put down at £157; maintenance of ways, £2,051 (or ·30d. per car-mile, as against ·28d. last year); £1,462 has been the cost of management; rents, rates and taxes, £1,839; miscellaneous, £966; insurance, £1,156; bringing up the total working expenditure to £34,460 (which works out at a cost of 5·06d. per car-mile, as against 5·75d. last year), leaving a gross surplus of £31,086, equal to 4·57d. per car-mile, as compared with 4·53d. last year. Interest on debt (£13,632) brings down the surplus to £6,816, equal to 1d. per car-mile, against 0·09d. (loss) in the previous year. Depreciation at 3 per cent. amounts to £11,687, leaving a deficiency of £4,872, equal to 0·72d. per car-mile, as against 1·64d. last year. It may be interesting to refer to the history of the undertaking during the past few years. The amount of deficiency for the year ended March 31st, 1901, was £10,100. The deduction of the amount of £5,000 transferred from depreciation account, left a balance carried forward of £5,100. To this must be added a deficiency of £9,144 for the year ended March 31st, 1902, making a total of £14,245. From this was deducted £5,209, being the amount of rate-in-aid, equal to 3d. in the pound, leaving a balance to be carried forward of £9,036. The deficiency at the end of the financial year of 1903 was £8,918, which, added to the cost of the Almondbury accident on June 28th, 1902, which amounted to £3,396, brought up the total to £21,350. From this was deducted the amount of rate-in-aid, equal to 7d. in the pound, £12,235, leaving a balance to be carried forward of £9,115. The deficiency for the year ended March 31st, 1904, was £4,871, which leaves a debit balance of £13,987, which will be dealt with by a rate-in-aid or otherwise. On the depreciation and contingencies account the balance brought forward is £13,554, and this, with the transfer for the year of £11,687, brings up the total to £25,241.

**Liverpool.—Southport Electric Railway.**—On Sunday, for the first time, a 40-minutes' service of electric trains was worked between Southport and Liverpool, and *vice versâ*, on the new L. & Y. electric railway. Trains were run between Southport and Crossens. The trains, which consisted of three cars, were largely patronised. The third class carriages repeatedly overflowed and many had to travel first class. Some fifteen minutes was saved by the journey, though some confusion was caused by persons not leaving the cars in the prescribed order, and time was thus lost on the journey.

**Manchester.**—The "budget" of the tramways department has been issued this week. The Committee estimates the traffic revenue for the current year at £635,583, and miscellaneous revenue (including payment from Salford for the use of certain city lines) at £5,082, making the total income £640,665. For the year ended March 31st last the estimated income was £537,699, whilst the approximate income amounted to no less than £611,830. It is estimated that the current year's expenditure will be £434,903, the principal items being:—Power expenses, £110,563; traffic expenses, £211,021; rent of tramways, £21,390; repairs and maintenance, £51,054; general expenses, £39,875. It is proposed to appropriate the balance of £205,762 as follows:—Interest on loans, &c., £50,033; sinking fund and instalment on loans, £34,822; renewal fund (permanent way), £51,600; depreciation and reserve fund, £19,307; leaving a surplus available for the city fund (in relief of rates), £46,000; and infirmary purchase, interest, &c., £4,000. For the year just closed the estimated outlay was £184,820, and the approximate expenditure £191,880, whilst £50,000, as estimated, was handed over to the city fund. On capital account the estimated expenditure is £124,000, against an approximate expenditure last year of £356,493. The main items are: land and buildings, £4,400; cars and car equipments, £67,000; permanent way, &c., £7,500.

The Manchester Tramways Department has recently had 50 cars equipped with the Westinghouse electro-magnetic brake.

The frequency of street accidents, and the ineffectiveness of the tramcar life-guards, caused much comment at last week's Council meeting. Replying to a question on this subject, Mr. Boyle, chairman of the Tramways Committee, took the opportunity of saying that much of the advice given by coroners' juries was useless. Considering that the Manchester cars ran 38,000 miles per day, and 43,000 miles on Saturdays, along crowded streets, he said the wonder was that accidents were not more frequent. It had cost Manchester £3,000 to comply with the Board of Trade's request to substitute the "gate and cradle" guard for

the "cow-catcher"; and in 30 cases of accident this year life had been saved, in all probability, by that apparatus. If any better guards were invented, the Tramways Committee would be only too glad to adopt them. It may be desirable to state in this connection that a new form of life-guard was tested at Bury lately, with very satisfactory results. It is the invention of Mr. Philipson, of Astley Bridge.

Thanks to tramway competition, railway fares on most of the lines round Manchester are being reduced. The Great Central is now issuing cheap monthly tickets available to or from stations within a 10-mile radius; and last week a reduction of its fares to Levenshulme, on the Stockport line, was announced by the London and North-Western Co. The return railway fare is cheaper now than by the electric cars.

**Newcastle-on-Tyne.**—A meeting of the Tramways Committee was held on the 14th inst., Councillor Cail presiding, when a deputation was appointed to attend the conference of municipal bodies throughout the country at the Westminster Palace Hotel, to consider the position created by the application of the Tyneside Tramways and Tramroads Co. for power to run over a portion of the Corporation's lines. During the proceedings, which were of a lengthy character, Mr. Cail, the chairman, and Mr. J. J. Gillespie, vice-chairman, each stated their intention of resigning, and the meeting was adjourned.

**Paris Underground Railway.**—A Dalziel telegram from Paris says that the new City of Paris loan of 170,000,000 fr. for the further extension of the Metropolitan Underground Railway was covered 89 times.

**Radcliffe.**—The Radcliffe District Council has arranged with the Corporation of Bury for the laying of an electric tramway in Radcliffe. Radcliffe will lay the permanent way; the electrical equipment and cars will be provided by Bury, and the traffic will be worked by the Bury Council under a 30 years' lease. Current for traction will be obtained from the works of the Radcliffe Urban Council. The Bury Corporation guarantees a quarter-hour's service throughout the day. Direct communication with Manchester is aimed at.

**Southport.**—The gross receipts of the Corporation tramways for the year ending March 31st, amounted to about £18,000, while the working expenses came to about £11,000, showing a surplus on the working of about £7,000. There will have to be deducted the usual payments for sinking fund and interest, which will amount to £7,500 or £7,600, leaving a total deficit of £500 or £600. Last year the gross income was £16,387 and the working expenses £11,231. It is not expected that any money will be required from the rates, as there is sufficient margin from the working of the lines leased to the Tramways Co. to make good the loss.

**Stirling.**—The T.C. on Monday agreed to have a report upon the subject of the electrification of the tramway within the burgh and Bannockburn, in addition to the report upon the electrification of the entire system from Bridge of Allan to Bannockburn. The correspondence with the local authorities interested and with the tramway company was submitted. The company asked £21,000 for its system.

**Sunderland.**—Messrs. Wilford & Son, solicitors, of Sunderland, have received a letter from Mr. Herbert Jekyll, of the Board of Trade, intimating that the latter, after considering the report of their Inspector, have decided not to sanction the construction of the loop line proposed to be made at Roker to ease the holiday and summer traffic. The Committee's suggestion was to make a short circular loop to obviate the necessity of shunting, and it was strenuously opposed by the owners and occupiers of adjacent residential property.

**West Bromwich.**—The Trades Council is petitioning the Town Council to use its influence with the tramway company with the view of introducing halfpenny stages on the respective routes, in fulfilment of a promise made at the commencement of the undertaking.

## TELEGRAPH AND TELEPHONE NOTES.

**Melbourne.**—The *Australian Electrical Record*, of March 10th, says that the Commonwealth electrical engineers of the Postal Department have been holding a conference in Melbourne respecting the regulations recently issued in connection with the telegraph and telephone lines in the light of representations made by the municipalities affected.

**The Telephone Question.**—At the Court of Common Council last week, it was resolved that the Streets Committee be authorised to arrange a conference at the Guildhall of representatives of local authorities in the London telephone area with reference to the proposed purchase by the Government of the National Telephone Co.'s undertakings.

**Wireless Telegraphy.**—In the House of Commons on Thursday, April 14th, in reply to Sir J. Leng (Dundee), who asked the Postmaster-General whether he could now state what arrangements had been made with the Post Office for facilitating the receipt and forwarding of Marconi telegrams, Lord Stanley said that negotiations on the subject were still in progress. He hoped, during the course of the Session, to make a statement on the subject of wireless telegraphy generally, and the arrangements which he hoped to conclude with the Marconi Co. in particular.

### Telegraphic Interruptions and Repairs :—

| Cables, | Interrupted. | Repaired. |
|---|---|---|
| Dominica-Martinique | May 5, 1902 | |
| St. Lucia-Martinique | May 7, 1902 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Cayenne-Pinheiro | Aug. 18, 1902 | |
| New York-Hayti | April 18, 1903 | April 15, 1904 |
| Anjer-Kalianda | Aug. 2, 1903 | |
| Reissa-Issa (Yemen)-Camaran | Oct. 22, 1902 | |
| Tourane-Amoy | Nov. 10, 1903 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed { Nagasaki-Vladivostock | Feb. 15, 1904 | |
| Closed { Port Arthur-Chefu | Feb. 18, 1904 | |
| Foochow-Formosa | Feb. 11, 1904 | |
| Dakar-Conakry | April 11, 1904 | |
| **Landlines.** | | |
| Seoul-Masampo | Feb. 13, 1904 | |
| Seoul-Gensan | Feb. 13, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Saigon-Bangkok | April 12, 1904 | April 13, 1904 |

**Wireless Telegraphy and War.**—The *Times* correspondent at Wei-hai-Wei has been doing excellent service with his de Forest wireless telegraph apparatus on the steamer *Haimun*. Admiral Togo, also, as the reports of last week's naval encounter showed, has derived considerable advantage from the possession of wireless telegraph equipment. The result of these enterprising performances is the following Russian declaration :—

"In case neutral vessels, having on board correspondents who may communicate news to the enemy by means of improved apparatus not yet provided for by existing conventions, should be arrested off Kwan-tung, or within the zone of operations of the Russian fleet, such correspondents shall be regarded as spies, and the vessels provided with such apparatus shall be seized as lawful prizes."

It is understood that the Russian notification to suppress the use of wireless telegraphy by newspaper correspondents has been made to all the Powers. There have been many protests against this high-handed action. The *Times*, which is the only paper, so far, directly concerned, comments on the matter, thus :—

"At present it seems that the only installation of wireless telegraphy for the purpose of newspaper correspondence is that on board the *Times* steamer *Haimun*. Our special correspondent has for some time been cruising in the Yellow Sea, communicating from a British ship with British territory at Wei-hai-Wei by means of instruments of which the ownership is British and the patent American. He has been in frequent contact with Japanese vessels, and Admiral Togo could at any time have exercised the strictest supervision over his correspondence. Not only has our correspondent performed his duties without any objection being raised by the Japanese authorities, who, indeed, permitted the steamer to sail from a Japanese port, but on April 6th he was overhauled and boarded by the Russian cruiser *Bayan* flying the flag of a Russian admiral. The officer in command of this vessel sent two lieutenants aboard the *Haimun*, who politely examined her papers, the log, the crew, the wireless telegraphy plant, and our correspondent's messages. These officers only detained the *Haimun* long enough to satisfy themselves as to her mission, and then permitted her to hold on her course. The Russian Government has now made the sudden discovery that an enterprise which has been carried on for some weeks past with the full knowledge of both belligerents is of so dangerous a character that it must be suppressed by the most violent means. It is a little doubtful whether, in the present condition of their fleet, the Russians are in a position to carry out their threat; but, if chance delivered the *Haimun* into their hands, they could attain their end without perpetrating what, in the eyes of all civilised peoples, would be an outrage. There are other ways of preventing the transmission of news besides summarily disposing of a responsible newspaper correspondent as a spy. Neither we nor our correspondent would raise any objection to the most rigorous censorship exercised in accordance with the principles recognised in modern warfare. We make no doubt that the Japanese, if they had considered it necessary, would have exercised their right of censorship long ago. The Russians may argue that they have not similar opportunities for controlling the *Haimun*, but a war correspondent, not possessing an astral body, has to confine his activities to the seas or the territory occupied by one of the belligerents, and Admiral Alexeieff surely could not expect our correspondent to put in periodically to Port Arthur to submit his messages to a Russian censor.

"What perplexes and annoys the Russians is, as Count Cassini's note indicates, that they have to deal with 'improved apparatus not yet provided for by existing conventions.' Instead of trying to devise means to meet this new situation, and incidentally to turn it to their own advantage, they propose to employ a method of brutal repression which is certain, in the long run, to defeat its own purpose. They will find that the application of scientific discoveries to modern requirements cannot be checked by means which may be effective within the region where the Russian bureaucracy is still supreme."

**Electrical Standardising, Testing and Training Institution.**—We are informed that, as a result of the recent scholarship examination, Leonard Van Vestrant, of the Grammar School, Wellingborough, has been awarded a Faraday Scholarship of 80 guineas per annum, tenable for two years.

## SUNDERLAND CORPORATION NEW ELECTRICITY WORKS.

The Corporation of Sunderland commenced to supply current in March, 1895, from its first station at Dunning Street. The growth of output has been uniform and continuous, and the tramway plant, which was laid down at the first station in 1900, having utilised the whole of the available space, rendered it necessary to build the second and principal station at Hylton Road.

In previous issues of the Electrical Review (August 16th, 1895, and September 5th, 1902) we have published descriptions of these two stations; the following particulars, for which we are indebted to the borough electrical and tramways engineer, Mr. J. F. C. Snell, relate to the extensions recently carried out.

At Dunning Street there are 11 engines of 200 and 500 H.P. respectively, aggregating 2,165 KW. This plant, owing to the position of the site, is non-condensing, excepting the tramway units, for which the circulating water is re-cooled by a fan-draught tower. The coal has also to be delivered by carts.

In 1901, the Corporation acquired a site of three acres at Hylton Road, where there already existed a deep well, lined

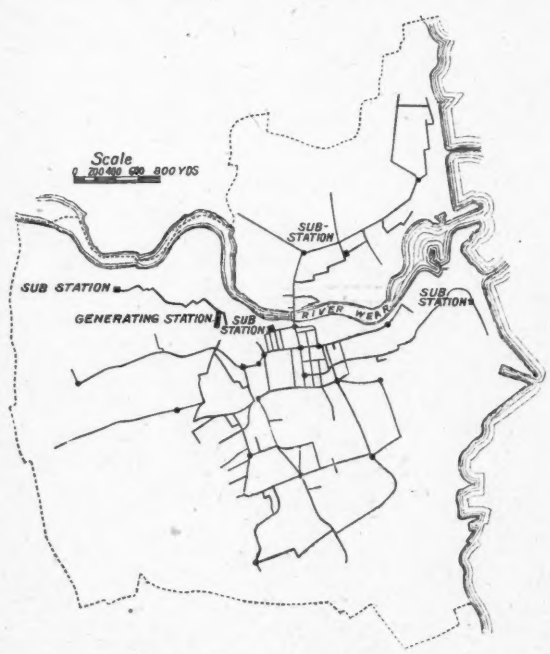



Fig. 1.—Map of Area Supplied.

with masonry, from which a copious supply of water is obtained from the underlying Permian beds, and at which the levels are such, that coal is delivered by means of a viaduct, direct from the Hetton Collieries into the station overhead bunkers. The site is some 90 ft. above the river level, as it is practically impossible to obtain a riverside site, owing to the prevalent shipbuilding industry, and so far, therefore, the circulating water supplied from the station well is re-cooled by a fan draught Klein tower. As the station grows, water will probably be elevated from the river by combined motor-turbine pumps, and delivered into an auxiliary reservoir in the station grounds. There are now installed eight Belliss & Morcom engines, five coupled to direct current Silvertown dynamos, aggregating 1,280 KW., and three new sets coupled to three-phase alternators by the Electrical Co., Ltd., with a total output of 2,250 KW., making 3,530 KW. in all at Hylton Road station, or a total of 5,695 for the two stations.

The system has been, until recently, partly the original three-wire 110-volt system installed to Prof. Alexander Kennedy's specification, and partly a two-wire 220-volt system. The original three-wire system has been done away with, and a uniform system of distribution is now obtained from the two wires. The principal reasons for adopting this system in preference to the more usual three wires, were partly on account of the large demands which may be expected from the 21 shipbuilding and engine works in the borough, a large number of which are already electrically equipped with 220-volt motors, driven from the works' own generating plant, and also because of the engineer's steady development towards sub-station distribution in Sunderland, as will be seen from the accompanying diagram of the system. The principle of the distribution at which he is aiming is to generate three-phase currents at one station, at a pressure of 5,000 to 5,500 volts, and transmit to sub-stations where the current will be transformed by motor-generators, and distributed to areas, the biggest radius of which will not exceed five-eighths of a mile. In each of these sub-stations there will be a large storage battery.

There are already two of the largest and most important works connected, each of which is equipped with its own sub-station; the first is the North-Eastern Marine Engineering Co., Ltd., at the South Docks, which company has installed a complete system of induction motors to the specifications of Mr. Wilson Carr, of Newcastle (its consulting engineer). To supply these works the Corporation has put down a sub-station in a separate small building at the works (fig. 3) which contains three standard transformers, each of the three-phase type, and each having an output of 300 KW. Each transformer is immersed in oil, and contained in a special cast-iron case, with radiating gills, so as to provide a very large cooling surface. As a matter of fact, after a week's run at about three-quarters load, the temperature rise is barely perceptible. Each transformer weighs about 2 tons complete and is mounted on rollers.

There are two 0·1 sq. in. three-core feeders laid from Hylton Road to this sub-station, each of which is connected to its own feeder panel; each feeder panel containing the well-known A.E.G. switch fuse, ammeter transformers, and panel isolator. There is a separate panel to control each transformer, each equipped with the panel isolator, instrument transformers and switch fuse. The whole is securely caged off, and locked in the usual manner.

The low-pressure mains consist of copper strip connecting the transformers with the low-pressure meter panels in an adjoining room, in which the company's distributing board is also erected. There is a low-pressure panel to each transformer containing an ammeter, voltmeter, earthing device, three-pole switch, and two single-phase A.E.G. wattmeters, which have been fixed on account of a possible want of balance between phases, due to the lighting circuits in the works. The primary voltage is 5,000, and the secondary 240, at a frequency of 50 cycles per second. The sub-station has been constructed with every precaution against danger to person or from fire.

The total number of motors installed is 22, with an aggregate capacity of 520 H.P., including some very fine 60-ton travelling cranes, supplied by the British Thomson-Houston Co., but this will be doubled in the future.

This consumer alone is expected to take some 600,000 to 800,000 units per annum. The company's enterprising directors and general manager (Mr. G. Weir) are well pleased with the installation.

The second important consumer is Messrs. William Doxford & Sons' shipyard, where there are at present 23 motors connected, representing 445 H.P.; but the ultimate connection, upon which the contract with the Corporation is based, is for motors with a total output of 1,892 H.P. In this case one-half of these important works is supplied from Messrs. Doxford's own generating station, in which are four triple-expansion Sunderland Forge steam dynamos, representing a total output of 800 KW., and of which Mr. W. Vidal is the resident electrical engineer.

The second half of the works, now under construction, is being driven from the Corporation's Pallion sub-station, in which are installed two A.E.G. synchronous motors, coupled to compound wound multipolar dynamos, each of 250 KW., at a pressure of 220 volts; the synchronous stator receiving three-phase current at 5,000 volts. To run up these machines there is installed a motor-generator by the A.E.G. of 30 KW. output, consisting of a three-phase induction motor receiving current at 240 volts from a three-phase oil transformer, and direct coupled to a four-pole shunt wound 220-volt dynamo.

The switchboard is in two sections; the high-pressure switches, &c., being mounted on the wall at the back of the

board, and consisting of two feeder panels similarly equipped to those at the South Docks, and also two machine panels, each containing an isolator, instrument transformers, A.E.G. oil break switch, and high-pressure fuses. The whole of the high-pressure work is caged in, under lock and key. The low pressure instruments are mounted on marble panels, and contain the usual magnetic cut-outs and main switches of the standard A.E.G. type.

The sub-station is connected by both private and National telephones to the generating station, and is equipped with a five-ton travelling crane.

This consumer will require an output similar to the North-Eastern Marine Engineering Co.

Two synchronous motor-generators have been installed at the old station in Dunning Street, each of 250 KW. capacity (fig. 4). These machines are identical with the Pallion machines above described, except that they are shunt-wound, and arranged so as to be reversible; *i.e.*, they are capable of being driven from the direct current side, and generating three-phase currents, or *vice versâ*. The addition of these synchronising panel has also been erected for future extensions. The machine room of this sub-station is shown in fig. 7.

On the first floor there is a battery of 120 cells made by the Electrical Power Storage Co., each cell being capable of discharging at 800 amps. for one hour, with a minimum voltage of 1·85, or 260 amps. for seven consecutive hours. A milking booster and switchboard by the Sunderland Forge and Engineering Co., Ltd., has also been supplied.

A southern sub-station at Hendon is about to be commenced, and will shortly be in operation. This will be on the same lines as the Monkwearmouth station.

The three-core mains are laid everywhere in duplicate, and through about one mile of the town are drawn into Doulton stoneware casings, 12-way, embedded in concrete, and with manholes 80 yds. apart, built in 18-in. brickwork; the insides are lined with white glazed bricks. The lowest boxes are connected to the sewers, and each box is drained to the next by means of a 2-in. wrought-iron pipe embedded in concrete. The highest boxes are ventilated.

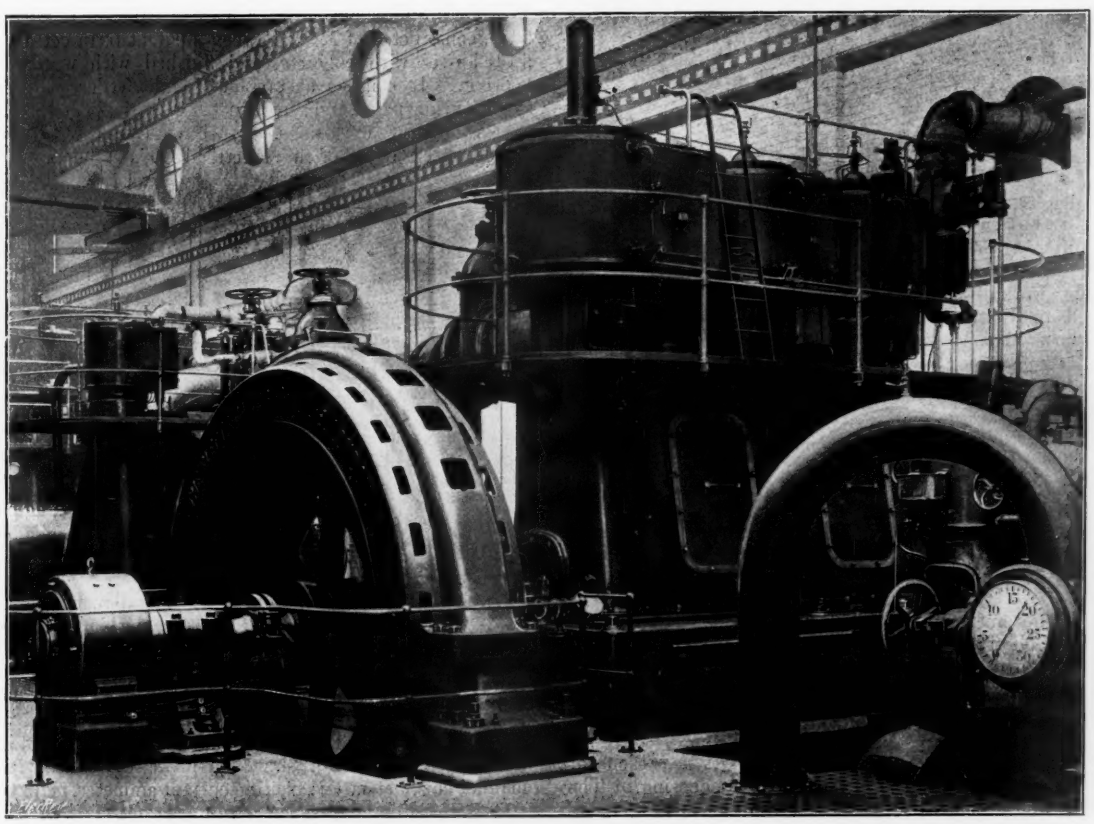


Fig. 2.—Belliss & Morcom Engine and Electrical Co.'s 750-kw. Three-phase Alternator. (See p. 668.)

two motor-generators has enabled the whole of the day load to be dealt with from Hylton Road.

The switchboard is of a very similar character to that at Pallion, and is shown in fig. 5. It is intended to install two 500-KW. induction motor-generators for either tramway or lighting purposes; each motor being coupled to two 250-KW. compound wound machines, arranged to run in series or parallel, and it is intended ultimately to convert the whole station into a sub-station driven from Hylton Road.

A large sub-station has been erected at Monkwearmouth, which will be capable of holding 2,500 KW. The first installation consists of two 125-KW. induction motor-generators; the motors are started up through slip rings with a water resistance, and are arranged with the usual short-circuiting lever. The multipolar dynamos are shunt wound, and are arranged to give from 220 to 250 volts. There is also a motor-driven battery booster, which has a maximum output of 500 amperes, at any voltage from 0 to 80.

The switchboard is similar in design and principle to those described above, but also contains a booster panel with reversing switch, and low pressure panels, with two bus-bars, plugs, and the usual standard equipment of instruments. A

The whole system has remained perfectly dry and clean. The conduits and the cables drawn into them were supplied and laid by Callender's Cable and Construction Co. Beyond the termination of this conduit system, the cables are laid solid in cast-iron trenches, filled with compound, the whole being supplied and laid by the British Insulated and Helsby Cables, Ltd. The joints (besides being accurately surveyed and recorded on a 44-in. plan) are marked on the street by letters and figures recessed into the pavement. The cables are everywhere three-core; each ·1 sq. in. section, paper insulated, lead-covered and steel armoured, the armouring being carefully bonded at each joint and earthed at several points along each line, and under each manhole in the conduit system there are copper earth plates embedded in coke, to which each cable sheathing is connected.

The cables were all tested to 18,000 volts for half-an-hour at the respective works, and to 12,000 volts after laying, and there has not been the slightest trouble in any way. At one place in the South Docks route the cables have been taken across the dock to the North-Eastern Marine Engineering Co.'s works (which are situated on an island), and had to be drawn through a submerged tunnel under the dock

sills; here 4-in. special cast-iron pipes with easy quarter bends, and with specially long sockets, were fixed, the tunnel being kept dry by special pumps, temporarily erected for the purpose; the cables were easily drawn through these afterwards.

Fig. 3.—Transformer Room, N.E. Marine Engineering Co.'s Works.

The whole of the outside work was carried out under the supervision of the distributing engineer, Mr. J. F. Moore, A.M.I.M.E., and the absence of trouble throughout the contracts and afterwards, reflects great credit upon him, and upon the contractors.

At the Hylton Road generating station, each of the three steam alternators has an output of 750 kw. The engines are of the well-known Belliss & Morcom type, each of 1,100 b.h.p., triple-expansion, surface condensing. The speed is 250 r.p.m. The steam consumption with a range pressure of 160 lbs. per sq. in., and with 100° F. of superheat, and when exhausting into a 25-in. vacuum, was 13·91 lbs. per b.h.p.-hour at full load, equivalent to 20·26 lbs. per kw.-hour. The alternators were supplied by the Electrical Co.; each is provided with a separate exciter coupled to the end of the alternator shaft, and is wound to give 78 amperes per phase, on a non-inductive load, and 91 amperes on an inductive load, with a power factor of 0·85, and a pressure of 5,500 volts between phases. The alternators (as can be seen from fig. 2), are of a massive and rigid construction. The armature casting is in two parts, the upper and lower of which are bolted together, and are carried by two feet at opposite ends of a diameter. These feet are bolted to two sole plates, and are also provided with the A.E.G.'s standard method of centring the armature with regard to the fields, which can be quickly done at any time. There is also an adjustable screw pillar placed under the centre of the lower half of the armature, so that it is quite impossible for any strain set up in it to cause the slightest want of alignment. The laminations are packed into the armature casting, and are kept in position by bolts passing through from side to side.

Each section is wound with two cotton-covered wires in parallel, which simplifies the operation of winding, and allows of its being done rapidly. The armature windings were tested with 15,000 volts for half-an-hour, and the machines, when running, may be short-circuited without fear of damage; the short-circuit current being specified not to exceed twice the full load current. The fly-wheel carrying the field magnets is secured to the shaft by two keys which are first driven up tight, and then two rings are shrunk on to the boss. The iron circuit for the fields is laminated, the laminations being carried on the periphery of the wheel between two circular plates, to which they are secured by bolts and nuts. To give the utmost rigidity taper keys are also inserted, one from each side, and driven up tight. The pole-pieces are carried on the outside of the laminations, into which they are dovetailed and secured by two taper keys, which construction allows of a pole-piece being removed in a short time without disturbing the armature. The pole shoes are also detachable, so as to allow of the former-wound winding being slipped off without delay, should occasion arise. The field magnets are excited in series at 220 volts from the above-mentioned independent exciter, which is carried outside the tail bearing, or independently from a separate source.

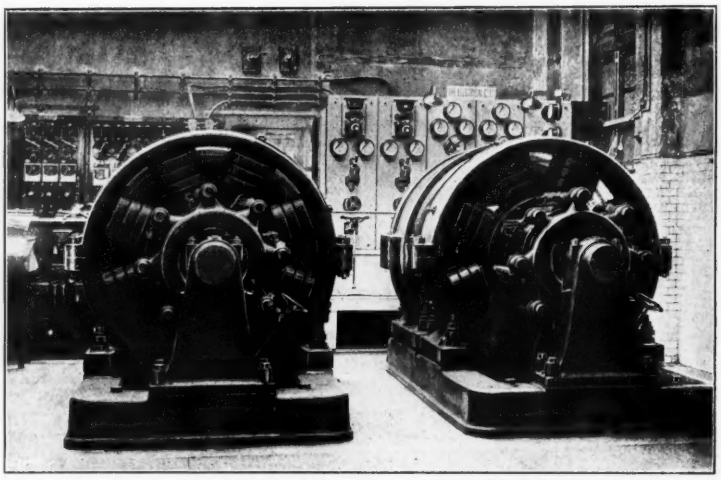


Fig. 4.—Motor-Generators, Dunning Street.

The high-pressure switchboard is carried on a raised platform, constructed of Mark Fawcett's patent terra cotta work, floated over with concrete, and finished with wood block flooring. It consists at present of eight feeder panels, one synchronising panel, and three generator panels, with two blank panels for future extensions. This board (like the others previously described) is of the Electrical Co.'s standard design, which makes it absolutely impossible for the attendant to touch any of the high-pressure work. The front panels of the board are of white marble, each circuit panel carrying one shunt low pressure ammeter, and one insulated oil switch hand-wheel. The synchronising panel carries three electrostatic voltmeters giving the potential difference between the bus-bars and earth, synchronising voltmeter and lamps, bus-bars, voltmeter and pilot voltmeter. Each dynamo panel carries a shunt low-pressure ammeter in the main circuit, wattmeter, exciting current ammeter, main generator oil switch hand-wheel, two-way exciting switch, with field breaker, and exciter field rheostat; and in front of each panel the vertical hand-wheel for regulating the resistance in the field circuit.

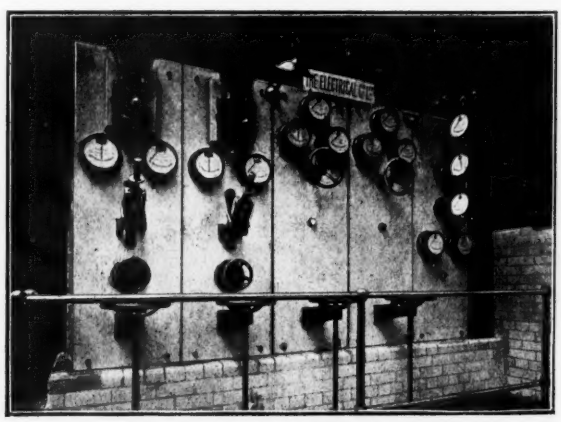


Fig. 5.—Switchboard, Dunning Street.

The back of the board is protected by a wire-work screen with door, each circuit and dynamo panel being isolated by a slate slab 1½ in. thick, so that any breakdown shall be entirely confined to its own compartment. There is only one set of bus-bars, so as to simplify the board.

The framework consists of channel and angle iron, and no wood or other inflammable substance is anywhere used. Below the platform, also protected by metal screens, are the three-way cable boxes, at which the main cables terminate, and three-pole magnetic blow-out lightning arresters, with non-inductive water resistance discharge for each feeder; the three field rheostats; two exciting bus-bars, together with one integrating watt-meter, with current and pressure transformers for each generator. As with the switchboard itself, all cables are carried on insulators, mounted on the iron framework, so that a fire about the board should be rendered absolutely impossible.

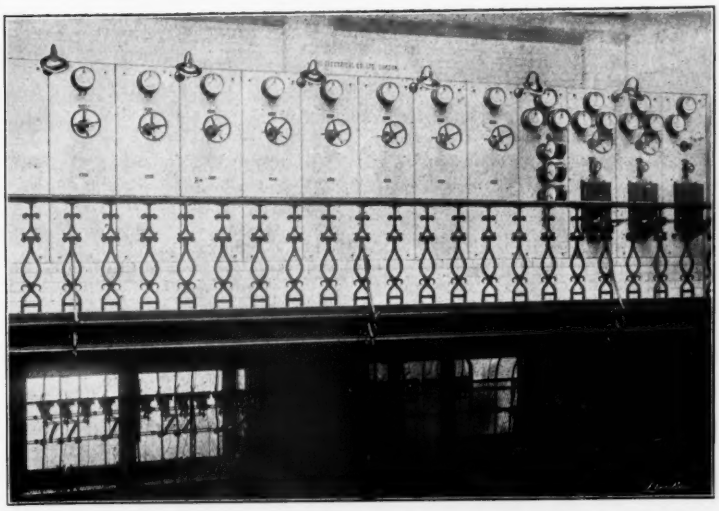


Fig. 6.—Main Switchboard in Power Station.

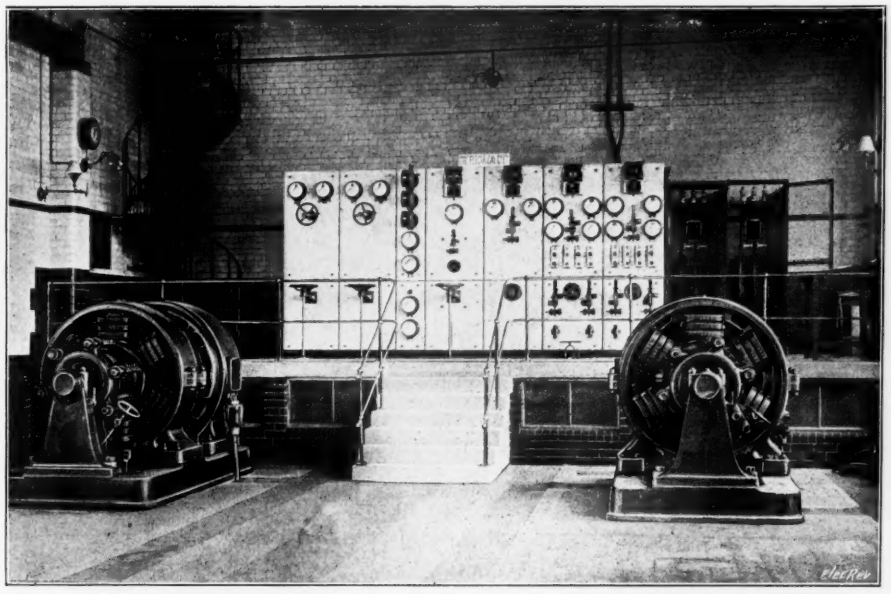
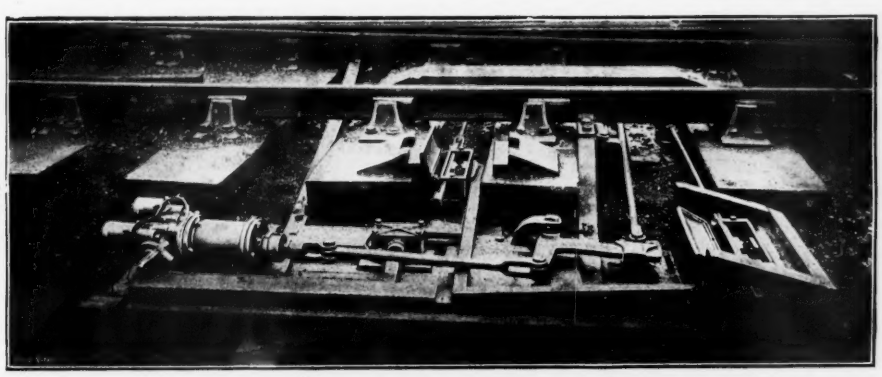


Fig. 7.—Interior of Sub-station, Monkwearmouth.

Two additional Galloway boilers, 30 ft. × 8 ft. 6 in. have been installed, together with superheaters at the back of each boiler, also by Messrs. Galloways, Ltd., of Manchester, each boiler being fitted with the "Triumph" mechanical stokers. An additional economiser by Messrs. E. Green and Son, Ltd., Wakefield, containing 360 tubes, has also been fixed, and a motor-driven "Sirocco" fan by Messrs. Davidson, of Belfast, driven by a 60-h.p. direct current motor manufactured by the British Electric Plant Co., of Alloa. An additional surface condenser containing 4,500 sq. ft. surface has been provided by Messrs. Alley & MacLellan, Ltd., of Glasgow. The whole of the pipe work is of steel with cast-steel tee-pieces and valve bodies, by Hopkinson, of Huddersfield; this pipe work was supplied and erected by the Wearmouth Foundry Co., of Sunderland. At the present moment a load factor is being obtained from this station of 41·6 per cent., and it is hoped that a very material reduction in the cost of generation will be made.

Mr. Edward White, A.M.I.E.E., station superintending engineer, supervised the whole erection of the plant inside the generating stations, and has carried out the work with great success. The electrical contract has been supervised on behalf of the Electrical Co. by Mr. A. E. Hadley, with Mr. F. J. Rynd as resident engineer. The latter has carried through the whole of this work without the slightest hitch.



L. & Y. Railway, Bolton New Station: Fig. 4.—Point Motor and "Indication" Boxes Controlling Double Catch Points. (See p. 672.)

The whole of the work was carried out to the specifications, and under the superintendence, of the borough electrical and tramways engineer, Mr. John F. C. Snell, M.I.C.E.

## LANCASHIRE AND YORKSHIRE RAILWAY: BOLTON NEW STATION.

Anyone taking a journey through Bolton Station three years ago must have formed a very unfavourable impression



Fig. 2.—Electric Signal Lamp.

The old waiting rooms—dark and poorly ventilated—have given place to a fine suite of buildings, generally regarded as models of railway requirements. The dining and refreshment rooms are luxuriantly fitted with every accommodation, and the effect of "Nernst" lamps on stained glass windows makes it difficult for one to realise that this is a railroad junction situate in grimy Lancashire.

In order to afford ample clearance under Trinity Street bridge, the permanent way has been lowered to a depth of 5 ft. for a distance of 600 yards. Excavations of this kind are not difficult where a new line is being constructed, but when it is remembered that Bolton *new* station has been erected on the site of the *old one*, and a fresh formation level obtained without accident or disorganisation of traffic, the achievement is eminently satisfactory.

It is, however, to the electrical part of this extensive alteration that we desire more especially to refer. A capacious power house has been built adjacent to the passenger station, comprising boiler house, dynamo room, and accumulator house, together with five workshops; the latter are allotted to telegraph linemen, hydraulic fitters, lamp trimmers, and joiners. These repair shops are sufficiently large for the local staff to deal with ordinary maintenance

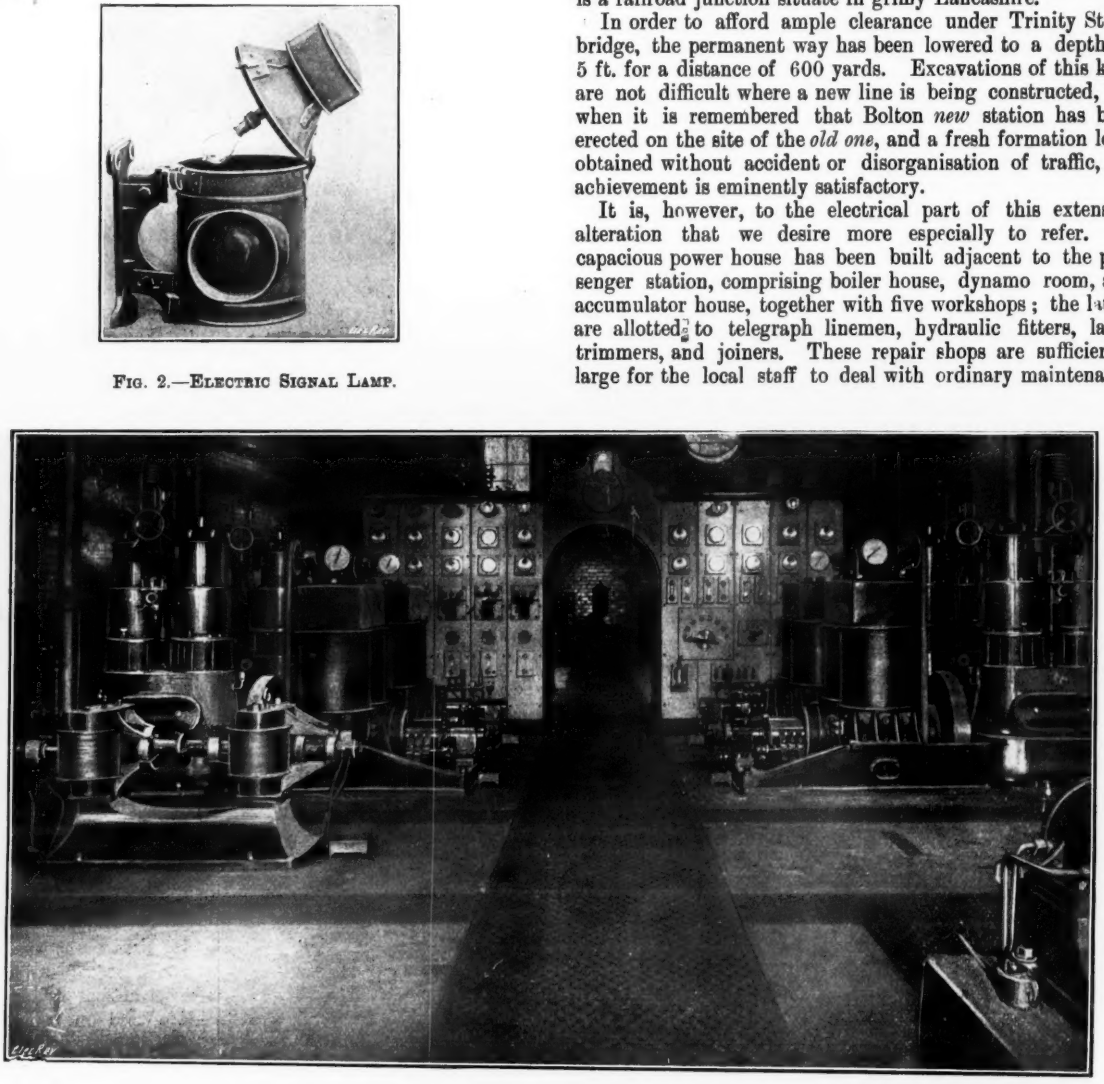


Fig. 1.—Interior of Power Station.

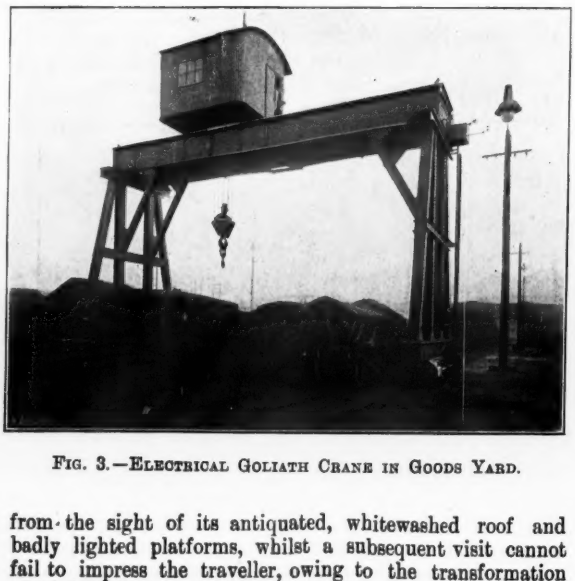


Fig. 3.—Electrical Goliath Crane in Goods Yard.

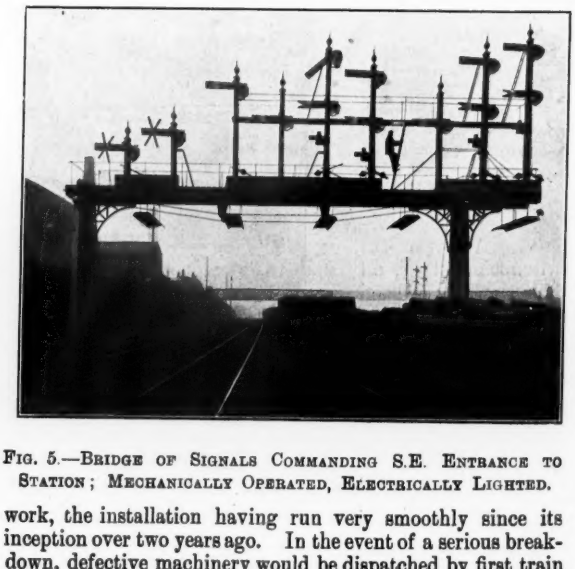


Fig. 5.—Bridge of Signals Commanding S.E. Entrance to Station; Mechanically Operated, Electrically Lighted.

from the sight of its antiquated, whitewashed roof and badly lighted platforms, whilst a subsequent visit cannot fail to impress the traveller, owing to the transformation which has recently taken place.

work, the installation having run very smoothly since its inception over two years ago. In the event of a serious breakdown, defective machinery would be dispatched by first train to Horwich — the chief engineering works, six miles

away—where a miniature engine and "cab" meet the branch and main line trains for the purpose of conveying stores, &c., to and from the shops: with such facilities, extensive repairs are carried out with a minimum of delay.

Messrs. Yates & Thom, Blackburn, were entrusted with the provision of four Lancashire boilers, working at a pressure of 160 lbs. per sq. in. Feed water after passing through the crank chambers is heated by "Row" tubes, after which it is raised to a high temperature with Green economisers: a large proportion of escaping heat is thereby arrested, the steaming capacity increased, and a reserve of water at a temperature of about 280° F. is always available. Metals laid parallel to the power house admit of coal being discharged direct to the bunkers.

The adjoining room, 96 ft. long by 33 ft. wide, is reserved for a hydraulic engine, air compressors and generating plant. Four high-speed, single-acting tandem compound engines are at work—specially designed by Mr. Hoy, late chief mechanical engineer to the L. & Y. Railway. These engines are similar in outward appearance to the ordinary wholly enclosed type, but an examination of the mechanical details reveals a number of entirely new features. An exhaustive account of them is outside the scope of this article, but reference can be made to our contemporary, the *Engineer*, January 30th, 1903, where a lengthy description is supplemented by numerous diagrams.

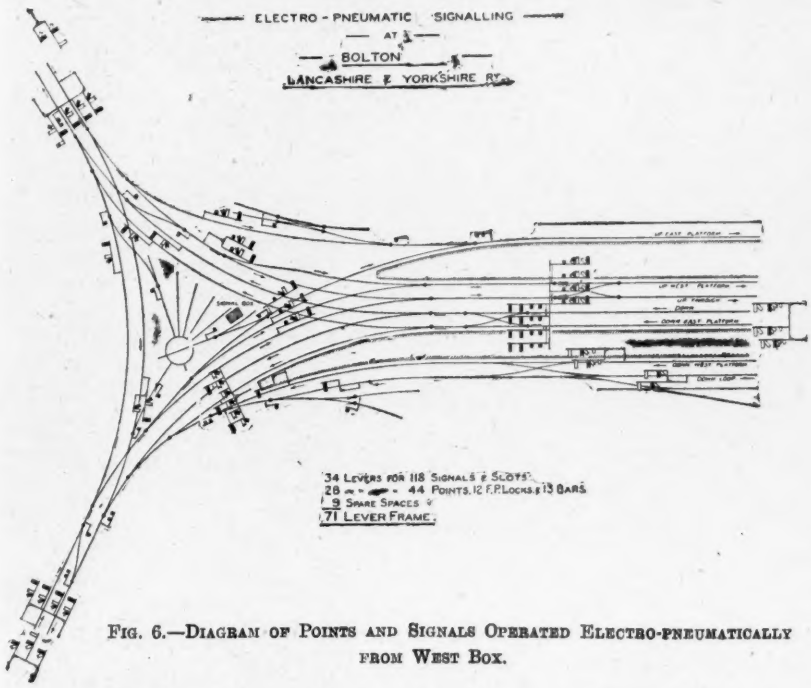

ELECTRO-PNEUMATIC SIGNALLING
AT
BOLTON
LANCASHIRE & YORKSHIRE RY.
34 LEVERS FOR 118 SIGNALS & SLOTS
28 " " 44 POINTS, 12 F.P. LOCKS & 13 BARS
9 SPARE SPACES
71 LEVER FRAME.

FIG. 6.—DIAGRAM OF POINTS AND SIGNALS OPERATED ELECTRO-PNEUMATICALLY FROM WEST BOX.

The dynamos (also designed by Mr. Hoy) are bipolar shunt-wound machines and are direct coupled. Constructed to run at 220 volts and 460 r.p.m., they have a capacity of 62-KW. each. Considering the heavy peak loads incidental to railway working, these generators approximate most favourably to sparkless commutation.

An illustration of the switchboard is shown in the background of fig. 1 on the opposite page. In this design an endeavour is made to combine architectural beauty with practical utility.

Twenty panels of white marble, 8 ft. long × 16 in. wide, are bolted to an ironwork structure, the latter being secured in a concrete floor. Five panels nearest the dynamos are each equipped with a complete set of apparatus for controlling one machine. Messrs. Nalder Bros. & Thompson supplied the requisite measuring instruments, together with automatic circuit-breakers.

The remaining front portion is fitted with various appliances for controlling the accumulators, whilst the back part of the switchboard is reserved exclusively for branch circuits. Fireproof doors enclose the rheostats, earth-testing devices and cables, and sand and water fire-buckets are close at hand in case of necessity.

A battery made by the Chloride Electrical Storage Co. has been installed, and consists of 112 Chloride cells, having a normal discharge of 112 amperes for 9 hours, with a maximum emergency rate of 500 amperes. Joined to the bus-bars, the battery works in parallel with the machines.

Each cell is periodically inspected, and whenever an irregularity in gassing occurs, or the specific gravity of the electrolyte falls below the normal, a portable milking booster is utilised to put matters right. This small machine is capable of developing 50 amperes at 3 volts.

The "Goliath" crane depicted on the opposite page was made by Chaplin & Co., Glasgow. About the time of its completion, 2½ years ago, the railway company received an order from Messrs. J. Musgrave & Sons, Ltd., Bolton, to load up a large quantity of ironwork. A casting weighing 46 tons was safely lifted by this electric crane, and the total consignment, amounting to 2,000 tons, was loaded up and dispatched to Glasgow Corporation with commendable promptitude. The crane has been in constant use ever since.

Seventeen electric capstans, designed and built at Horwich, are in use day and night for hauling heavily-laden wagons into position. Each capstan is revolved by a series-wound motor secured beneath iron bedplates. Ball bearings are provided to take the thrust of the worm, and these, along with the worm wheel, are immersed in an oil bath. Current is supplied to the motor when the chargeman depresses a pedal. Iron-cased fuse boxes, and suitable starting resistances, are all fixed below the pavement level. This interesting method of dealing with goods yard traffic has largely displaced the time-honoured shunting engine, and a great saving is thereby effected.

Messrs. P. & R. Jackson, Ltd., Salford, fitted up 20 electric cranes on the loading stage of the new goods warehouse, two having a lifting capacity of 50 cwt., and the remainder 30 cwt. each; by this means, goods are transferred direct from the railway wagon to the carriers' lurry. The contract also included a 30-cwt. electric lift, which is utilised entirely for conveying merchandise to and from the various floors in this great warehouse.

We should add, parenthetically, that novel devices, with fusible wires, are connected at the latter place, so that in case of conflagration, massive fire-proof doors would close automatically, and so limit the damage to a narrow area.

If a consignee prefers to have his goods stored for an indefinite period, electric "jiggers" are used in the following manner:—A rope is lowered from the top storey, where a 20-B.H.P. motor (supplied by Messrs. Bruce Peebles) is conveniently located. At a given signal the goods are hoisted out of the train, through several trap doors, to the particular storey assigned for them by the inspector on duty. Automatic starting rheostats of Sturtevant's design work in connection with these "jigger" motors.

Mention should also be made of five "Waygood" electric lifts at the passenger station; this improved mode of dealing with parcel traffic and passengers' luggage is highly appreciated by all concerned.

Widespread interest has been aroused amongst railway circles in consequence of a new signal box being operated by electro-pneumatic power. This cabin, which commands the west and northern entrances to the new island platforms, was opened last September for passenger and goods traffic.

One electro-pneumatic frame controls the whole of the triangle (shown diagrammatically in fig. 6) hitherto worked by two separate boxes. The levers are only 6 in. long, and are easy to manipulate. One of the chief merits of this system lies in the relief which it brings to the muscular exertions of the signalman.

It is the usual practice to connect each signal to a separate lever by means of a stranded steel wire, and to mechanically unite all points with their respective levers by iron rods. In the present case, signal wires and point rods are conspicuous by their absence; not only so, but two or three signals are now lowered by *one* lever, as set forth in fig. 6, which is approximately correct.

Seven secondary cells, having an E.M.F. of 14 volts, suffice to energise every electro-magnet about the place. Allowing 68 milliamperes per coil, the maximum output never exceeds 4 amperes.

Compressed air at 60 lbs. per square inch is conveyed from the power house to the various signals and points, each of which is provided with a motor containing a cylinder and piston, governed by inlet and exhaust valves; these are actuated by currents from the signal box. The quantity of air used is very small, amounting to not more than half a cubic foot of free air per movement per lever. The mechanical and electric interlocking is so arranged that when the point movement is complete, *but not before*, a return current from the points unlocks the lever, permitting the stroke to be completed. And if, after this is done, some unauthorised person succeeded in fouling the points in question, every signal protecting those lines would instantly revert to danger; this is accomplished by means of electric detectors fixed alongside each "facing" point.

This brief description of the electro-pneumatic signalling, as supplied by the Westinghouse Brake Co., and fitted up by the railway employés, will give a rough idea of the precautions taken to safeguard the travelling public.

We understand that the electric lighting installation will not be completed until a pile of offices above the main entrance is finished. Rapid progress is reported in connection with the electrification of signal lights, covering a large area. Paraffin lamps are being replaced by 8-C.P. 230-volt lamps. This represents 10 volts in excess of the working pressure, and the lights are proportionately dim. Sufficient brilliance, however, is obtained for signal lanterns, and the life of the filament is considerably prolonged. By securing the lampholder as illustrated in fig. 2, p. 670, it is only necessary to turn back the lid, and an oil lamp can easily be inserted. Provision is thus made against the remote possibility of electrical failure.

Eight hundred lights are distributed about the station and goods yard, comprising 28 open arc, 70 enclosed, and the remainder incandescent, including sunbeam and radiator lamps.

Messrs. Veritys, Ltd., and the General Electric Co. supplied the majority of these lamps, whilst the contracts for cables were placed with Glover's, Salford, Craig Park Co., and the British Insulated Co., respectively.

An inspection of the cattle pens, or of the platform lighting, alike confirms the impression that the Horwich engineers recognise the commercial value of abundant light, and Bolton New Station may fairly claim to be one of the most up-to-date railway centres in the United Kingdom.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.**—April 30th. Condensing plant, pump and piping. See "Official Notices" April 15th.

**Abergavenny.**—May 24th. Electric lighting of Monmouthshire Asylum. See "Official Notices" to-day.

**Ayr.**—May 20th. Boiler, buildings, engines, dynamos, switchboard, wiring, mains, &c., for the District Lunacy Board. See "Official Notices" to-day.

**Cleckheaton.**—May 2nd. 350-KW. steam generator. See "Official Notices" to-day.

**Chili.**—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

**Clyde.**—May 23rd. Electric wharf cranes for the Clyde Navigation. See "Official Notices" to-day.

**Dublin.**—May 9th. Steam three-phase extra high-pressure set (1,000 to 1,500-KW.), piping and switchboard. See "Official Notices" April 15th.

**Dundee.**—April 30th. General stores, electrical goods, &c., for the Electricity Department. See "Official Notices" to-day.

**Edinburgh.** — April 23rd. Switchboard extension, piping. See "Official Notices" March 25th.

**France.**—April 26th. The French Ministry of the Colonies in Paris are inviting tenders until the 26th inst. for the supply of 120 tons of galvanised iron telegraph wire for Indo-China. Particulars may be obtained from, and tenders are to be sent to, Le Ministère des Colonies, 4, Rue Jean Nicot, Paris.

**Glasgow.**—May 9th. Four sets of 800-KW. dynamo panels for the Electricity Department. See "Official Notices" to-day.

**Govan.**—April 26th. Stores, &c., for the Electricity Department. See "Official Notices" April 15th.

**G.W. Railway.**—April 26th. Four 200-KW. and ten 400-KW. motor-generators, four cooling towers, cranes, and coal and ash conveying plant, for Park Royal generating station and various sub-stations. See "Official Notices" April 1st.

**Hackney.**—May 26th. Electricity supply mains. See "Official Notices" to-day.

**Hammersmith.**—May 18th. Two 1,500-KW. steam turbines or low-speed engine generating sets, with condensers; boilers and superheaters. See "Official Notices" April 15th.

**Heckmondwike.**—April 26th. Feed pumps, steam traction generator, boiler, switchgear, induced draught apparatus, and underground feeders. See "Official Notices" April 15th.

**Ilkeston.**—May 7th. Advertising on the electric cars.—See "Official Notices" to-day.

**Italy.**—August 18th. Tenders are being invited until August 18th next by the municipal authorities of Amelia (province of Umbria) for the electric lighting of the town.

**Kilmarnock.**—May 17th. Permanent way work. See "Official Notices" April 15th.

**L.C.C.**—May 17th. Extra high-pressure three-phase board, low-pressure combined direct and three-phase ditto, sub-station and transformer boards for Greenwich power station. See our "Official Notices" April 15th for particulars.

**Manchester.**—April 28th. 90-B.H.P. water-turbine, dynamo, electric motors, overhead equipment for railway track, switchboard, &c., for the Waterworks Committee. See "Official Notices" April 15th.

**Melbourne.**—May 13th. One 750-KW. direct-current steam dynamo. See "Official Notices" March 18th.

**Newport (Mon.).**—April 22nd. The T.C. is prepared to receive tenders for the supply of w.i. tie-bars for the Stow Hill tramways, in accordance with plans and specifications, to be seen at the office of the borough engineer, Mr. R. H. Haynes.

**Natal.**—May 9th. Electric telpherage system for Bonded Warehouse. See "Official Notices" March 18th.

**Poplar.**—May 7th. Cables and battery. See "Official Notices" to-day.

**Royton and Crompton.**—April 30th. Permanent way. See "Official Notices" April 8th.

**Wallasey.**—April 27th. Stores for the Electricity Department. See "Official Notices" April 15th.

**Wallasey.**—May 7th. Condensing plant. See "Official Notices" April 15th.

### CLOSED.

**Burton-on-Trent.**—The Corporation has placed an order with Messrs. Bruce Peebles & Co., Ltd., for a 500-KW. single-phase alternator, direct-coupled to a Willans & Robinson central valve engine.

**Gravesend.**—The T.C. has accepted the following tenders for supplies to the electricity works:—

Reason Manufacturing Co., Ltd., indicators.
The Electrical Co., Ltd., lamp stores.
Ferranti, Ltd., meters.
Thomas Stone & Co., F. Bird & Co., and W. H. Wilcox & Co., Ltd., engine stores.

**Hackney.**—The B.C. has placed an order with Messrs. Brown & Sons, Dalston, for 15,000 pairs of carbons, suitable for 10-ampere lamps, at 30s. per 1,000 pairs.

**Halifax.**—The Corporation has ordered two "single-attendant" tramcars from the Brush Electrical Engineering Co.

**Handsworth.**—The U.D.C. has accepted the tender of Mr. George Holloway, of Wolverhampton, for the construction and electrification of the tramways at £9,945.

**Ilford.**—The U.D.C. has accepted the tender of the British Thomson-Houston Co., Ltd., Rugby, for the supply of B.T.H.-Edison incandescent electric lamps, O.K. ampere-hour meters for the 12 months ending March, 1905.

**Keighley.**—The T.C. last week accepted contracts for the new tramways and electrical equipment to the amount of £21,231 9s. 6d.

**Keighley.**—The Brush Electrical Engineering Co. has received from the Corporation Tramways Department (per British Thomson-Houston Co.) a contract for eight double-deck cars with Brush trucks.

**Metropolitan Asylums Board.**—A tender from the Electrical Power Storage Co., Ltd., to maintain the storage battery at the Brook Hospital for five years for £58 15s. per annum was accepted by the Board on Saturday.

The Board received the following tenders on Saturday for installing fire alarms and telephones at the Leavesden Asylum:—

| | |
|---|---|
| Mason, Cash & Co., Woodville Electrical Works, Burton-on-Trent (accepted) | £294 0 |
| Donnison, Sillem & Co. | 310 0 |
| F. Hodgson & Co. | 359 0 |
| Lea, Son & Co. | 361 0 |
| Cox-Walkers | 368 0 |
| D. Firth & Son | 376 0 |
| P. Dewhirst | 421 10 |
| Gent & Hurley | 429 19 |
| Watford Engineering Works | 450 0 |
| J. T. Mayfield & Co. | 454 0 |
| A. V. Gifkins & Co. | 457 0 |
| Private Wire & Telephone Installation Co. | 457 19 |
| W. J. Furse | 470 0 |
| Willey & Co., Ltd. | 475 0 |
| Watkins Bros., Ltd. | 479 8 |
| Jackson Bros. | 515 0 |
| W. S. Wilson | 549 0 |
| Tamplin & Makovski, Ltd. | 568 0 |
| F. J. Coleby & Co. | 587 10 |
| Electrical Engineering & Maintenance Co. | 638 0 |
| P. J. Driscoll | 715 0 |
| S. E. Haward & Co., Ltd. | 774 0 |
| National Telephone Co., Ltd. | 960 0 |

It was reported that the engineer-in-chief's estimate was £450.

**Pontypridd.**—The tenders of the following firms for free wiring have been accepted by the U.D.C.:—

South Wales Electrical Co.
Messrs. Alger & Sons, Newport.
Messrs. Arnold & Co., Newport.
Messrs. Bedford & Gray, Cardiff.

**Poplar.**—The Council on 7th inst. accepted the following tenders for sub-station plant; Mr. P. N. Hooper, borough electrical engineer and manager:—

Motor-Generators.

| | |
|---|---|
| Electrical Co. | £7,892 0 0 |
| British Thomson-Houston Co. | 8,323 0 0 |
| British Westinghouse Co. | 8,345 0 0 |
| Dick, Kerr & Co. | 8,532 0 0 |
| Mather & Platt, Ltd. | 8,740 0 0 |
| General Electric Co. | 9,060 0 0 |
| Bruce Peebles & Co. (accepted) | **9,060 10 0** |
| Johnson & Phillips | 9,205 0 0 |
| Siemens Bros. | 9,661 0 0 |
| Electric Construction Co. | 10,075 0 0 |

Switchboards.

| | |
|---|---|
| Johnson & Phillips | £2,970 0 0 |
| Cowans, Ltd. (accepted) | **3,078 10 0** |
| Kelvin & White | 3,297 12 6 |
| Ferranti, Ltd. | 3,600 0 0 |
| Siemens Bros. & Co. | 3,670 0 0 |
| Electric Construction Co. | 4,537 0 0 |
| British Thomson-Houston Co. | 4,960 0 0 |

Travelling Cranes.

| | |
|---|---|
| Carrick & Sons, Edinburgh | £512 |
| Carrick & Ritchie, Edinburgh (accepted) | **560** |
| Hitchin, J., Halifax | 550 |
| Marshall, Fleming & Jack, Motherwell | 555 |
| James Spencer, Manchester | 630 |
| Pickerings, Ltd., Stockton | 641 |
| Hunter & English, Bow | 690 |

**Salford.**—The tender of the Lancashire Dynamo and Motor Co., Ltd., of Trafford Park, has been accepted for motors of 5 H.P. and upwards, for the ensuing year, this being the third year in succession.

**South Africa.**—The East Rand Proprietary Mines have placed an order with Messrs. Bruce Peebles & Co., Ltd., for a 250-KW. direct-coupled set.

**St. Pancras.**—The Electricity Committee has received the following tenders for two steam turbines, each of 1,000-KW. capacity, to replace four of the old engines and dynamos at King's Road station:—

| | |
|---|---|
| C. A. Parsons & Co. | £12,495 |
| Do. alternative scheme (recommended) | 14,000 |
| British Thomson-Houston Co., Ltd. | 12,580 |
| Willans & Robinson, Ltd. | 13,706 |
| Richardsons, Westgarth & Co. | 15,012 |

**Worcester.**—The T.C. has accepted the tender of the Nevile Engineering Co. for the erection of an iron platform and staircase for the switchboard at the Powick generating station at £90, and that of Electromotors, Ltd., for the supply of motors on the hire-purchase system.

## FORTHCOMING EVENTS.

Friday, April 22nd.—At 5 p.m. Physical Society Meeting.
At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). "The Equipment and Maintenance of Electric Street Cars," by Mr. C. W. Crosbie.
At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders, at Newcastle.
Tuesday, April 26th.—At 8 p.m. Institution of Civil Engineers. Annual General Meeting.
Wednesday, April 27th.—At 7.30 p.m. Institution of Electrical Engineers (Students). "Insulation and Insulators," by Mr. H. D. Symons.
At 2.30 p.m. Institution of Civil Engineers (Students). Visit to the Metropolitan Railway Electric Power Station at Neasden.
Thursday, April 28th.—At 5 p.m. Royal Institution. Prof. Dewar on "Dissociation." (Lecture III.)
At 8 p.m. Institution of Electrical Engineers. "Power Station Design," by Messrs. C. H. Merz and W. McLellan.
At 8 p.m. Liverpool Engineering Society. Annual general meeting.
Saturday, April 30th.—At 10 a.m. Institution of Electrical Engineers (Students). Visit to the Western Electric Co.'s works at North Woolwich.
Association of Engineers-in-Charge. Bohemian Concert.

## NOTES.

**South African Notes.**—*Durban (Natal).*—The Electric Light Committee of the above Corporation has recommended the following reduction in charges for electric current:—(1) That the annual charge, payable monthly, of £5 per H.P., stand as at present. (2) That all consumers of power be required to state at the outset, under which tariff they propose to come; whether the 2d. per unit rate and £5 per H.P., or the 4d. per unit rate, and no charge for H.P.; and, having once settled, no change from one tariff to the other be allowed, unless six months' notice be given. (3) That the following be the tariff of charges for electrical power:—Up to 3,000 per month, 2d. per unit; from 3,000 to 10,000, 15 per cent. allowed; over 10,000, 35 per cent. allowed. Each month's account to be dealt with on its own merits, so that one month's account is not to be set off against another. (4) That consumers of over 500 units per month of current for lighting be allowed a discount of 15 per cent. on all consumption over 500 units. (5) That the above alterations to tariff shall take effect from April 1st next.

A Bill is to be introduced into the Cape Parliament to obtain authority for the Municipal Council of Aliwal North to construct an electricity supply works.

The Queenstown Municipality is also seeking powers to erect telegraph and telephone lines.

*East London.*—The T.C. has approved the recommendation of the committee to the effect that the electrical mains be extended along Bayswater Road for street and house lighting; also that permission be granted to the town electrical engineer to erect, for purposes of trial at places most suitable . . . . five arc lamps of a certain design submitted as samples by the South African agents of the Western Electric Co., U.S.A.

*Kroonstad.*—The T.C., on 21st ult., authorised the Deputy-Mayor (Mr. Hoseason), in the absence of the Mayor, to sign the electric lighting contract with Messrs. Davies & Spain. The contract was accordingly signed the following morning.

*Rand Mines.*—The directors' report of the Central Geduld Gold Mining Co., Ltd., states:—"Arrangements are being concluded with the Proprietary Co. for the supply of electric power for all future purposes from the Rand Central Electric Works. Electric mains have been laid over your property, and the installation is now being completed. The current will be distributed as required, and will be used for pumping, lighting, machine tools, &c. In the directors' report of the North Geduld Gold Mining Co., and also in that of the Geduld Proprietary Mines, it is stated that arrangements have been made for the supply of electric power from the Rand Central Electric Works, and in the accounts of the latter company there appears the item: 'Electric power installation, £7,500 10s. 6d.'"

*Pretoria.*—The T.C. has addressed a letter to the railway authorities, asking whether it would be possible to have electric signals placed at the crossings in Church Street West and Walker Street.

*East London.*—During a sharp thunderstorm on the night of 21st ult., the lightning struck an electric light pole in Quigvey, and for a considerable time that portion of the town was in darkness. The local tram service was also interrupted.

*King William's Town.*—The Electric Lighting Committee reported to the T.C. that it had given instructions for the lighting service to be extended to new properties above Albert Road, near the Rifle Range.

*Salisbury (Rhodesia).*—The T.C. has adopted a committee resolution providing for the better supply of water and light for the town, the work to be undertaken "by a joint-stock company, a co-partnership or a concessionaire under agreement with the Council, which must also provide for electric light and power within the municipality, exclusive of any required by tramways." Mr. Crawford Lindsay, the Council's consulting engineer, has been empowered to "interview those desirous of entering into such an agreement."

*Howick.*—The local correspondent of the *Natal Mercury* laments that at the famous Falls in the vicinity so much "motive power runs to waste year after year. If harnessed it would" (he declares)

"supply electricity to an extensive area, besides furnishing power to innumerable mills and factories in the village. There is, I believe, a syndicate which has an 'option' on the Falls for 21 years. That syndicate must hurry up and make Howick a bustling industrial centre."

*Johannesburg.*—Mr. R. G. Fricker recently presided at the fourth ordinary general meeting of the General Electric Power Co., Ltd., the accounts of which showed a profit of £8,826 for the year. The chairman stated that since the close of the year under review, a further call of 1s. per share had been made for the purpose of extending the plant, necessitated by the growing demands upon its power. Another generator and the necessary boilers had been ordered, sufficient to satisfy the requirements of the various companies who were connected with the G.E.P. Co.'s works. For some time past a certain amount of current had been distributed to the municipality and householders in Germiston, and it had been suggested that an agreement for a term should be entered into for the purpose of continuing this supply, and the board had the matter under their consideration. The report was adopted, Mr. R. G. Fricker and Mr. F. D. P. Chaplin were re-elected directors, and the appointment of Mr. W. H. Dawe, as a director in place of Mr. J. G. Hamilton, resigned, was confirmed.

**The Electrolytic Separation of Metals.**—The metals, the polarisation pressures of which are superior to that of hydrogen (Zn, Cd, Fe, Co, Ni, Sn, Po), are not capable of being successively separated by means of a gradual increase in the electric pressure between the electrodes, though, according to theory, each metal should be deposited beginning with a certain pressure characteristic of the metal, and termed "polarisation pressure." This contradiction between theory and practice, as pointed out in a paper by Hollard and Bertiaux before the French Academy of Sciences, is only an apparent one, being due to the high resistance of the electrolyte, and the low intensity of the current traversing the latter with the electric pressure used. This current, precipitating one of the metals at the cathode, will precipitate at the same time the hydrogen of the bath; hence, instead of the total current, only a fraction of the current will be utilised for depositing metal, this fraction being much too small to give rise to a complete separation, especially at the end of the electrolysis, when the concentration of this metal in the bath is rather small, in accordance with Nernst's law. The high resistance of the electrolytic bath is especially due to the hydrogen given off at the cathode and the oxygen given off at the anode. By eliminating both of these gases, the authors have obtained for the same electric pressure a much stronger current producing the separation of the metals. Eliminating the hydrogen and using a tin or cadmium cathode, they were able to separate, *e.g.*, zinc and cadmium. By preventing the evolution of oxygen and using a soluble anode, they succeeded, on the other hand, in separating nickel and zinc. In the latter case the anode, being of amalgamated zinc, was dipped into a magnesium sulphate solution, separated by a diaphragm from the nickel zinc solution containing the platinum cathode. Unfortunately, with the latter method, the nickel being recovered, it is impossible to ascertain the amount of zinc remaining in the bath, because of its being mixed with the zinc sulphate due to the dissolution of the anode. The method described in this paper is free from this drawback, platinum anodes and cathodes being employed. The evolution of oxygen is avoided here by adding to the bath sulphurous acid, which is oxidised by the oxygen. The use of $SO_2$, however, required the following special measures of precaution:—Nickel and zinc sulphates, ammonia sulphate (10 grammes), magnesium sulphate (5 grammes), 5 cubic cms. of a saturated $SO_2$ solution as well as of ammonia are added, the electrolysis being effected at a temperature of 90° C. with a current of 0·1 ampere; after at most four hours, for amounts of nickel not superior to 0·25 gramme, a specimen of the bath should no more be blackened by ammonia sulphydrate, as this would indicate the presence of nickel.

**The Absorption of Radioactive Emanations.**—In a paper read before the Freiburg i.B. Society of Naturalists in April, 1903, Prof. F. Himstedt had shown that air, on being blown through water, will assume an electric conductivity up to 100 times greater than the initial value. These experiments have recently been continued by Freiherr Rausch von Traubenberg with the Elster and Geitel dispersion apparatus, the results being as follows:—

1. Cistern water will lose its ionising power, which may be restored to it by air being blown through it by means of a water blast.
2. All the liquids examined are susceptible of being excited artificially, this being especially true in the case of hydrogen carbide.
3. The ionising power of water appears to be due to a radioactive emanation dissolved in water, and following, like a gas, the law of Dalton-Henry.
4. The absorption coefficients of the various liquids with respect to this radioactive emanation are calculated from the equation governing the absorption of gases.
5. Radium emanations seem to behave with respect to absorption by liquids in a way quite analogous to the emanation from cistern water.

**McMillan Memorial Fund.**—Mr. R. Kaye Gray, President of the Institution of Electrical Engineers, states that from the result of the circular recently issued by the Council, it appears that many subscribers to this fund have assumed that the amounts named in the circular were the maximum sums expected. The Council now points out that this was not its intention. The fund at present makes a total of £1,325, and the Council feels that at least £2,000 is necessary if the scheme is to meet the object for which it was started. It is thought that many subscribers will be glad to have an opportunity of augmenting their subscriptions if the contributions made were fixed under a misapprehension.

**A "New Power" Invention.**—This is an age of invention; at least, so think the Patent Office. Anybody can invent; very few are refused the necessary or unnecessary protection for their ideas, the office above mentioned being one of the most obliging in the world to those who pay its fees. Some infinitely small percentage of these happy though reckless individuals succeed in recouping themselves for their time and expenditure through interesting others in their productions.

It may be some consolation to the crowd who remain outside the charmed circle to know that patrons are still obtainable with plenty of cash; no one need despair. Only last week we were introduced to a hybrid collection of wheels, chain and belt gearing, &c., bearing a distant resemblance to a cycle of some sort "run to seed," which is destined, without doubt, to revolutionize the art of locomotion, wherever mechanical means have been adopted for that purpose, if only a pigheaded generation can be hypnotised into believing in it.

Fancy, no more motor-cars and wagons (horses and cycles are already doomed)! No more electrical tramways, no need to spend vast sums on electrifying railways! The "new power" (a term invented by the same genius, presumably because the arrangement was otherwise indescribable) will abolish all this.

We were not favoured with any estimate of the size of a 10-ton road vehicle arranged on these lines; but, judging from the one man apparatus on view, it would not necessitate any special road widening, and 100 ft. would probably cover its length.

We purposely refrain from explaining the method of operation; we don't want to give the show away any more than the inventor did at his private view. It is, however, simplicity itself; to paraphrase Algy's explanation of the working of a locomotive, you "pull out a spring and away we go," nothing more is required; once put the arranged tension on the spring and this uncanny mechanism, alias "new power," carries it forward until—well, we thoughtlessly suggested "until it stopped,"—but the inventor suggests "till it is stopped." We have not seen it running, the authorities not being in a position to guard the route at the time, and the high powered motor-cars required to keep pace with the "new power" not being available. Still, we are promised a treat shortly, when the inventor will crush at one blow the absurd notions which have previously existed on the subject of perpetual motion by a demonstration on the road of his "new power" arrangement.

**Electricity in Mines.**—At a meeting of the Yorkshire branch of the National Colliery Managers' Association on Saturday last a paper was read by Mr. F. H. Waterhouse on the proposed rules for the use of electricity in mines. From an abstract in the *Yorkshire Daily Observer* we gather that after giving a summary of the rules proposed, Mr. Waterhouse advanced arguments to show that if they were carried into effect they would involve considerable trouble to managers and great expense to owners. In order to avoid danger, motor frames and coupled connections would have to be connected with earth, which, he said, would involve great expense. Then it was almost impossible to obtain this connection satisfactorily. He sought to show that generating stations in a great many cases would have to be rebuilt, for which purpose very few collieries had the necessary room, not to mention the requisite facilities. Mr. Waterhouse further pointed out that the amount of leakage allowed on the circuit, which was $\frac{1}{10000}$ of the maximum supply current, was only a small amount to allow, and the standard adopted was much higher than that fixed by electrical engineers for the wiring of houses. There was, however, a rule by the use of which leakages might be shown in the initial stage, thereby enabling a leakage to be estimated at once, and before any serious consequence could result. He was certainly of opinion that more switches would have to be used on a circuit than was the case at present. The carrying out of these rules, he said, would also necessitate additional stays and greater care in the mines. Mr. Waterhouse said he was decidedly of opinion that the rule requiring telephonic communication was a good one, as it would be a great advantage to be able to transmit information to the proper source directly anything wrong happened in the pit. Although they were in use in America he did not think that electrical locomotives were likely to be used in British mines. The discussion was adjourned until the next meeting.

**I.E.E. (Manchester Section).**—The annual meeting of this section was held on Tuesday evening, the 12th inst., Mr. E. W. Cowan presiding. The hon. secretary, in reading his annual report, stated that the membership of the Manchester Section had increased by 77, and the average attendance had also increased from 118 to 187. The newly-formed students' section had a membership of 250. A hearty vote of thanks was given to the retiring officers. For next session Mr. C. D. Taite was elected chairman; Mr. G. E. Giles, vice-chairman; and Mr. P. A. Ramage, hon. secretary and treasurer. During the evening an exhibition of specialities of local firms took place, which included arc lamps, switches, controllers, brakes, &c.

**I.E.E. (Glasgow Section).**—Before the meeting of this section on 12th inst., a paper on "Corporation Telephones," contributed by Mr. A. R. Bennett, was read, in the author's absence, by Mr. E. G. Tidd, hon. secretary. Mr. W. A. Chamen presided, and, after the reading of the paper, called upon Mr. H. L. Webb, of London, to open the discussion. The discussion was adjourned until May 10th.

**The Behr Mono-Rail System.**—On Monday, Mr. F. B. Behr gave an address before the London Chamber of Commerce on his mono-rail system and its application to the present requirements of locomotion. Sir Albert Rollit, M.P., presided. Mr. Behr described some recent improvements in the construction of the carriages for his mono-rail, which had been embodied in the working model which would be exhibited at St. Louis. He urged that the introduction of high-speed mono-rail lines was at present the only way to solve the problem of the housing of the working classes in the neighbourhood of large towns, at a reasonable cost, and with a prospect of earning a fair dividend on the capital invested.

**Tramways and Over-running Powers.**—On Tuesday, at the Westminster Palace Hotel, a conference of municipal authorities owning or working tramways was held to consider the question of over-running powers. A resolution was passed expressing the opinion that the granting by Parliament of running powers and compulsory traffic facilities over municipal tramways will be fraught with grave and undesirable consequences, and will be detrimental to the working of a large central tramway system. An executive committee, consisting of representatives of the Corporations of Birmingham, Liverpool, Manchester, Glasgow, Leeds, Cardiff, Sheffield, Newcastle-on-Tyne, and the L.C.C. (with power to add to their number), was appointed to take such steps as they deem necessary in relation to the matter.

**Electricity v. Gas.**—A correspondent, referring to the paragraph "Electricity *v.* Gas," in our last issue, regards the saving effected as very commonplace. A church in his neighbourhood which was fitted up with electric light, thereby effected a saving of over £2 per quarter. At the same time there is more than double the light there was with gas. In the case of some warehouses in the City, a net saving of £16 was made on the last quarter's account; some other warehouses in the East End showed a saving of nearly £60 on one quarter's account. These figures are net savings, and are altogether apart from the enormous advantages which nearly everyone knows electric light possesses. Our correspondent has many other figures, in connection with private houses, as well as business premises, which clearly prove that electric lighting can be made equally as cheap as gas. But he says it must be particularly borne in mind that the saving depends not only on the price of energy, but more particularly still on the way the installation is designed, in addition to the work being well executed.

**"Elements and Compounds."**—On Tuesday Prof. W. Ostwald delivered the Faraday lecture before the Chemical Society at the Royal Institution, taking the above as his subject.

**Cauvery Falls Power Supply.**—In the course of his speech to the shareholders of the Ooregum Gold Mining Co., on 19th inst., the chairman, Mr. Malcolm Low, said:—"Our supply of power from the Cauvery Falls has been uninterrupted throughout the year, and the machinery driven by it has worked perfectly well. Under agreement between the Mysore Government and the leading companies in the field, arrangements have been made to increase the supply of this power, and we shall get an additional 205 H.P., which will make up, with what we already have, altogether 1,157 H.P. as our share. You will have noticed that the cost per horse-power has been reduced from £29 to £18. As to the Kolar Mines Power Co., in which we possess 6,660 shares, its purpose is, I think, best explained by a remark in the report, which I will read to you:—'This is a company recently formed, with a capital of £30,000 in £1 shares, in order to supply electric power for the more economical working of certain machinery on the field, the running of which is intermittent. The shares are all held by the five leading companies working on the field, each company being entitled to receive power in proportion to its shareholding, this company having the right to 222 H.P. It is expected the work will be in operation towards the end of the present year.' This installation will give us a power, even more economical than a constant supply from the Cauvery Falls, for working certain classes of our machinery whose services are in occasional, and not constant, request."

**Egypt.**—Nobels, Ltd., have been authorised to import into Egypt (among other things) detonators, electric fuses, and electric detonators, for a space of five years, expiring on March 28th, 1909.

The *Egyptian Gazette* states that Sir William Willcocks has evolved a scheme for utilising the power of the sixth cataract, commonly called the Shabluka Cataract, for irrigating with the aid of electricity. By this means it is estimated that 250,000 acres in the neighbourhood of Khartum and down to the Atbara junction will be irrigated.

**The Tramways and Light Railways Association.**—The annual dinner of this Association was held on Wednesday last week at Princes' Restaurant, Piccadilly, Mr. Alfred Baker presiding.

**The Electrical Association of New South Wales.**—Our electrical friends in Sydney who are connected with the above Association, held a "continental" on the Sydney Cricket Ground on Friday, March 4th. Some 500 or 600 ladies and gentlemen were conveyed to the grounds in specially decorated electric cars.

**Municipal and County Club.**—The Lord Mayor of London will be the guest of the Municipal and County Club at their house dinner at the Club House, Whitehall Court, on Thursday, May 19th.

**Appointments Vacant.**—Shift engineer for Exeter (£2 2s.); assistant mains superintendent for Partick (20s.); assistant tramways engineer for Bolton (£150).

**The Next M.E.A. Meeting.**—The preliminary programme of the ninth Annual Convention of the Incorporated Municipal Electrical Association notifies the following arrangements:—

*Wednesday, June 29th, at Derby.*—Presidential address. Paper by Mr. C. E. C. Shawfield, of Wolverhampton, on "The Commercial Practicability of Electric Traction by Surface Contacts." Excursion to Chatsworth and Haddon.

*Thursday, June 30th, at Nottingham.*—Papers by Mr. S. L. Pearce, of Manchester, on "Polyphase Sub-stations; Their Equipment and Working"; Mr. H. Faraday Proctor, of Bristol, on "Some Notes on the Bristol Electricity Works Fire"; Mr. R. S. Downe, of Southport, on "Boiler House Economies." Visits to works. Annual dinner.

*Friday, July 1st, at Sheffield.*—Papers by Mr. Councillor Blakeway, of Southampton, on "The Financial Position of Municipal Electrical Undertakings"; Mr. A. Cridge, of Sheffield, on "The Organization and Management of the Meter Department." Visits to works.

*Saturday, July 2nd, at Derby.*—Annual general business meeting. The secretary of the Association is Mr. C. McArthur Butler, Staple Inn Buildings, Holborn, W.C.

**Personal.**—Mr. Charles J. Hall, M.I.E.E., has severed his connection with Messrs. John Fowler & Co. (Leeds), Ltd., Leeds, as electrical engineer, and has commenced to practice as a consulting engineer at East Parade Chambers, 10, East Parade, Leeds.

The Bradford tramway staff have presented a portmanteau and an umbrella to Mr. Lafferty, who is about to take up his duties as traffic superintendent of the Preston Corporation tramways.

Out of 79 applicants for the post of tramway manager at Rochdale, the following have been selected to appear before the T.C.:—Mr. J. Brindle, manager and secretary of the Rochdale Tramway Co.; Mr. S. J. D. Moffet, chief assistant in the Corporation tramways department; Mr. A. A. Blackburn, car-sheds superintendent at Manchester; Mr. W. Hutchings, traffic manager on the South Lancashire tramways, at Atherton; and Mr. W. Smith, manager of the Taunton and West Somerset tramways.

**American Electrical Fires.**—An American exchange (*Insurance Engineering*) says that Fire Report No. 42, issued recently by the Electrical Bureau of the National Board of Fire Underwriters, describes 28 fires caused by electricity, including the Iroquois Theatre fire in Chicago, and the theatre fire in Cleveland, that occurred during a presentation of the same play. In addition to the fires mentioned, 18 fires are reported as due to crosses of telephone, telegraph and signal wires with high potential circuits; 15 were caused by crosses of low and high potential circuits; 25 due to the grounding of circuits are reported, of which 14 were on building fronts, eight at gas pipes and two at metal ceilings; nine occasioned by short-circuits in flexible cords; seven fires were caused by the heat from incandescent lamps; five due to loose connection at switches and arc lamp terminals on series arc circuits; six caused by defective sockets and switches; five occasioned by open link fuses; five due to overheated resistances; six fires occurred in electric cars, two of which were due to overheated resistances and three to defective wiring. Reports of 168 electrical fires, with losses aggregating over $215,000, have been received during the last quarter. During the year 1903 a total of 25 electrical fires occurred in New York City, according to the annual report of the electrical department of the New York Board of Fire Underwriters, damaging property to the extent of about $10,250. Of these fires nine were due to direct short-circuit of conductors; nine due to grounding of conductors on metal pipes; six due to overheating of connections or devices, and one due to stock ticker wires underneath floor.

**Technical Training in America.**—In a report to the Department of Agriculture and Technical Instruction for Ireland, prepared by Mr. Robert Blair (Assistant Secretary to the department in respect of Technical Instruction) on his visit to America as a member of the Mosely Commission, a large quantity of interesting information is given, with numerous illustrations. Most of the report, we understand, is included in the conjoint report of the Mosely Commission; certain letters, however, will not be republished. The gist of some of these letters, which were written in reply to inquiries made by Mr. Blair, is given in the following summary:—In the Westinghouse shops and offices 160 college-bred men are engaged, out of a total of 10,000 employés. At the Carnegie Steel Works, where there are 7,000 hands, there were about 100 technically trained men, seven of the 23 leading officers being college graduates. Of 118 engineers on the staff of the Rapid Transit Railroad Commissioners of New York City, who are constructing a city underground railway, 84 per cent. had been college students; of 75 petty officers, 58 per cent. were college trained; in the Baldwin Locomotive Works, 43; on the Pennsylvania railway lines west of Pittsburg, 52, "nearly all being graduates"; at the Schenectady works of the General Electric Co., 264; the Illinois Central Railroad Co. employ 200 men who are "either graduates of a technical institution or have had some training in that line"; the Baltimore and Ohio Railway have employed in their maintenance of way department since January, 1901, 59 graduates of technical schools and universities, of whom 49 remain; the same company have this year begun to employ technical graduates in the yards and offices of the transportation department—17 have been thus engaged, 8 remain; in the mechanical and electrical departments the same company have 24 graduates among their 559 apprentices. These figures represent the specific statements made in some of the interviews and replies; the other statements were more general, the preponderance of opinion being in favour of technical graduates as industrial cadets.

**Calcium Cyanamide.**—Herr P. Bolin has recently published in the paper *Göteborgs Handel i Siöfartstidning* an account of the experiments which were carried out last year under his supervision at Edsby-Hof, near Stockholm, upon the value of calcium cyanamide as a fertiliser for the soil. Calcium cyanamide, or "Kalkstickstoff," as it is termed in Germany, is one of the most recent products of the electric furnace, being made by heating lime and carbon (as in the manufacture of calcium carbide) in presence of atmospheric nitrogen. The yield is a mixture of various compounds of calcium, the chief being calcium cyanamide, a body somewhat resembling calcium cyanide in composition. When pure, this substance contains 35 per cent. of nitrogen, but, as it comes from the furnace, it is contaminated with uncombined lime and carbon, &c., so that the actual samples tested by Bolin only contained 17·5 per cent. of nitrogen. When the cyanamide is wetted, as by contact with damp soil, it gradually decomposes into calcium and ammonium carbonate, the latter of which contains the nitrogen, and yields it up to the growing plants. Bolin's experiments corroborate what has been found already—that the material must be buried in the earth in order to prevent loss of ammonia, and that it must be used some time before its effect is needed. He recommends that the fertiliser should be buried to a depth of 4 in., and distributed 8 to 14 days before the seed is sown. His tests were made upon wheat, with various fertilisers and mixtures thereof, as shown by the following table. The quantities of calcium cyanamide and Chile saltpetre (sodium nitrate), viz., 150 and 225 kilos. per hectare of the former and 167 and 250 kilos. of the latter were taken as being equivalent. The entire amount of the cyanamide was used at one operation; the nitrate of soda in two lots, the first just before sowing, and the second at the beginning of last June. The superphosphate was of 2 per cent. and the potash salts of 37 per cent. strength. The crops were reaped on September 16th; those treated with nitrogen exhibiting a darker colour, and being taller than the others. The figures are kilogrammes per hectare, but may be converted into lbs. per acre by multiplying by 0·892:—

| | Corn. | Straw. |
|---|---|---|
| Unmanured .. .. .. .. .. .. .. .. .. | 1,843 | 3,057 |
| 300 superphosphate + 200 potash salts .. .. .. .. | 1,810 | 3,453 |
| 150 calcium cyanamide + 300 superphosphate + 200 potash salts | 2,340 | 4,527 |
| 167 sodium nitrate + 300 superphosphate + 200 potash salts .. | 2,753 | 5,447 |
| 225 calcium cyanamide + 300 superphosphate + 200 potash salts | 2,627 | 5,040 |
| 250 sodium nitrate + 300 superphosphate + 200 potash salts .. | 2,907 | 5,593 |

**Institution of Mechanical Engineers.**—The annual dinner was held on 14th inst. at the Hotel Cecil, with Mr. J. Hartley Wicksteed, President, in the chair. Dr. A. B. W. Kennedy proposed the toast of "Scientific Education," and referred to the progress which the scientific teaching of engineers had made during the past 30 years. Mr. Henry Hobhouse, M.P., responded. Mr. Balfour Browne proposed "Kindred Societies," and Sir William H. White replied. Dr. Glazebrook also responded. Sir Edward Fry proposed "The Institution of Mechanical Engineers," and the President responded.

**A New Steel-Tired Wheel.**—The *Street Railway Journal*, of March 5th, describes and illustrates a steel-tired wheel which seems to have points of advantage over the only type with which we are familiar in England. Instead of shrinking the tire on a cast-iron centre, the tire is heated, laid in a mould, and cast-iron poured in to form the centre. Although it is improbable that a perfect weld takes place, a similar junction to that obtained at a cast-welded rail joint is fairly certain to be made if the cast is done properly.

It is said that "fused steel-tired" wheels have been run until the steel was almost worn through without movement being observed. If a reduction of this nature can be guaranteed, although it would not be wise to run it down to that extent as a usual thing, a wheel tired in this manner should supersede the shrunk-on style. No particulars of cost are given, but considering that nothing more than the adherence of fusion, or partial fusion, is required to hold the tire rigidly on the centre, whereas machined tire rings and bolts generally have to be used to ensure the shrunk-on tire not moving, the actual cost of manufacture should be less. On the other hand, while the cast-iron centre of the shrunk-on wheel can be used again and again, and whereas the tires may be put on in the tramway or railway shops, the centre of the fused-tire wheel must be re-poured every time, and this would be done of necessity by the manufacturer.

If the process of casting has no injurious consequences, the two classes of wheel, when finished, are practically identical, and it is very necessary to have some reliable independent figures showing the prime cost and final cost per car-mile for a large number of each wheel before a useful comparison can be struck. Before recommending the fused wheel, we should want considerable evidence that there is no chilling of the rim of the centre after casting into a ring which is at a comparatively low temperature, in a mould of cold sand.

It is obvious that lateral movement of a fused-wheel tire can be rendered impossible by forging the inner circumference of the tire concave or convex, and this is certainly a point of some advantage over the shrunk-on tired wheel.

## THE CENTRAL STATION ENGINEER.

On p. 596 of our issue of April 8th we referred to Mr. Lance as retiring from the post of "senior engineer-in-charge" to the Brompton and Kensington Electricity Supply Co. This, we now learn, was not quite accurate, as Mr. Lance was shift engineer-in-charge. It was also stated that Mr. Langley is the resident engineer, but such is not the case. Mr. Whitie is the resident engineer, and Mr. Langley an assistant engineer. We are pleased to make these corrections.

Mr. W. L. Vitty, of the Dudley Corporation electricity works, has been appointed switchboard attendant at the Farnworth electricity works.

The staff of the Dover Electricity Supply Co. have presented a marble timepiece to Mr. V. P. Martin, on his marriage.

The Grays U.D.C. has increased the salary of the electrical engineer, Mr. E. D. Long, by £25 per annum, as from April 1st.

The Gravesend T.C. has granted a honorarium of 50 guineas to Mr. C. F. McInnes, electrical engineer, in consideration of additional work carried out since the Council dispensed with the services of a consulting engineer.

For the post of electrical engineer at Chester, 136 applications have been received by the T.C. The following have been selected to attend before the Lighting Committee:—Mr. W. J. Bache, Gloucester; Mr. S. E. Britton, Motherwell; Mr. L. A. Lee, Manchester; Mr. H. Richardson, Dundee; Mr. S. D. Schofield, Shipley; and Mr. P. S. Thompson, Malvern. The salary is £300 a year, rising by £50 per annum to £500.

The Radcliffe U.D.C. has appointed Mr. M. B. Henry, of Nelson, as electrical engineer, at an annual salary of £150. There were 100 applicants.

The River Tyne Improvement Commission on April 14th appointed Mr. Copeland as electrical superintendent of the Commissioners' Docks and Staiths.

The Leek Urban District Council has appointed Mr. Fred. Williams, of Maidstone, as assistant electrical engineer.

The Dorchester T.C. has offered Mr. W. J. A. Sowter, electrical engineer, £70 in lieu of notice. This is in consequence of the E.L. scheme having been abandoned.

The Liverpool City Council on Wednesday proposed to increase the salaries of a large number of officials, including the following in the electric supply and tramways departments:—Mr. A. Clough, resident electrical engineer, from £800 to £1,000; Mr. W. H. Collis, deputy-resident electrical engineer, from £500 to £550; Mr. B. H. Collins, chief clerk, from £350 to £375; Mr. C. R. Bellamy, general manager, from £1,200 to £1,500; Mr. C. W. Mallins, traffic superintendent, from £400 to £500, increasing £50 per annum to £600; Mr. W. H. Muckley, works superintendent, from £300 to £325, to be increased in 12 months to £350.

## NEW COMPANIES REGISTERED.

**A.E.G. English Manufacturing Co., Ltd.** (80,631).—This company was registered on April 13th, with a capital of £150,000 in £5 shares, to acquire any patents, patent rights or privileges relating to electric lighting, and in particular to take over the rights for the United Kingdom in an invention known as the "Nernst Lamp," to adopt an agreement between the Allgemeine Elektricitäts Gesellschaft, of Berlin (vendor company) of the one part, and this company of the other part, to construct, lay down, fix, and maintain cables, wires, accumulators, lamps, and other plant, works, and conveniences, and to carry on the business of producers and suppliers of electric light, mechanical engineers, electricians, suppliers of electricity for heat, motive power, or otherwise, manufacturers of electrical accessories, &c. The first subscribers (each with one share) are:—Franz Deutsch, Warnford Court, E.C., stockbroker; Felix Deutsch, Shiffbauerdamm, 22, Berlin, company director; C. F. de Nordwall, 2, Observatory Gardens, N., company director; H. Stottner, Weston House, Finchley Lane, Hendon, N.W., electrical engineer; O. Loewi, 67, Queen's Road, Finsbury Park, N., manager; C. Geistorfer, 42, Petherton Road, N., clerk; and S. Bensinger, 44, Digby Road, N., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are Felix Deutsch, Franz Deutsch, P. Mamroth, and C. F. de Nordwall; remuneration, 10 per cent. of the profits available for distribution, divisible.

**Hyderabad Electric Light and Traction Co., Ltd.** (80,635).—This company was registered on April 13th, with a capital of £10,000 in £1 shares, to construct, maintain, develop and extend or further the construction, equipment, extension and development of tramways, tramroads and light railways, to facilitate the working and maintenance thereof, to establish, promote and finance tramway, light railway and electric light and power companies, &c. The first subscribers (each with one share) are:—T. S. Turnbull, 13, Spring Gardens, Manchester, solicitor; F. H. Poole, 9, Wynstay Grove, Fallowfield, Manchester, solicitor; F. Cox, Ashdene, Kitts Moss Lane, Bramhall, Chester, accountant; J. C. Burrows, Wycliffe House, Westbourne Park, Urmston, gentleman; J. Oates, 35, Bellott Street, Cheetham, Manchester, accountant; F. W. Browne, 97, Langshaw Street, Old Trafford, accountant; and J. Hall, 20, Mocha Street, Lower Broughton, Manchester, clerk. No initial public issue. The first directors are J. Kerr and G. Flett; qualification, £100; remuneration as fixed by the company. Registered office, Worcester House, Walbrook, E.C.

## ELECTRICITY SUPPLY ACCOUNTS.

**Huddersfield Municipal Electrical Supply.**

We give herewith the returns of the Huddersfield Electricity Department for the past year. The undertaking has had a uniformly successful career for the past seven or eight years. The total units sold, according to the last return, has reached considerably over 1½ millions. The area of supply now covers Huddersfield and the Urban District of Linthwaite.

The total working costs are unduly inflated this year (as last year) by the inclusion under revenue of several abnormal items of ex-

penditure, and allowing for this, are very satisfactory. The year's working resulted in the earning of the largest net profit to date; this, as in previous years, was credited to depreciation.

The prices charged are:—Private lighting, 4½d. per unit, with discounts; power, 2½d. and 1d. per unit. The engineer and manager is Mr. A. B. Mountain.

GENERAL STATEMENT.

| For year ending December 31st— | 1903. | 1902. |
|---|---|---|
| Total capital expended ... ... ... | £173,507 | £164,596 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 1,462,501 | 1,207,837 |
| Public lighting ... ... ... ... | 97,459 | 90,388 |
| Total number of units sold ... | 1,559,960 | 1,298,225 |
| Equivalent No. of 8-C.P. lamps connected | 132,582 | 113,921 |
| H.P. of motors connected ... ... ... | 429 | 360 |
| Number of public lamps ... ... ... | 38 arc<br>56 inc. | 33 arc<br>62 inc. |
| Maximum load in KW. ... ... ... | 1,564 | 1,415 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £24,796 | *£22,125 |
| „ expenditure ... ... ... | †£11,362 | ‡£9,335 |
| „ profit ... ... ... ... | £13,434 | £12,790 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... | 3·94d. | 4·25d. |
| Public lighting ... ... ... ... | 1·84d. | 2·00d. |

REVENUE ACCOUNT FOR YEAR ENDING DEC. 31ST, 1903.

| | |
|---|---|
| Gross revenue ... ... ... ... | £24,796 = 3·82d. per unit. |
| Works and distribution costs (including public lighting) ... ... ... | †£8,816 = 1·35d. „ |
| Total working costs ... ... ... | †£11,362 = 1·75d. „ |

* Less certain discounts.
† Includes £2,623 cost of motors for hiring out, and of steam motor-wagon.
‡ Includes £1,400 legal costs and purchase of motors.

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £4,999 |
| Sinking fund ... ... ... ... ... ... | 4,783 |
| Balance on year's working transferred to depreciation account ... ... ... ... ... | 3,915 |
| Bad debts ... ... ... ... ... ... | 56 |
| Bank interest brought forward ... ... ... | —319 |
| Gross profit ... ... | £13,434 |

**Worcester Municipal Electrical Supply.**

As a result of the past year's working, and in spite of certain adverse conditions, the Worcester Electricity Department has contrived to show a more substantial net profit than on any previous occasion. Mr. C. J. Sutherland, the city electrical engineer, is to be congratulated on having successfully contended against a very bad year as regards water-power at the Powick station, which resulted in 116,928 less units than in 1902 being generated there, and as a direct result a decrease in the waterworks motors' account of £225.

Financial charges have increased, and the working costs are rather higher than in the previous year. The good features are the increased revenue from private and motor supply, and the year's revenue also includes an amount of £1,666 paid under agreement by the Tramway Co., who were not, however, in a position to take a supply until January 25th last.

The prices charged were:—Private lighting, 6½d. and 3d.; power, 2½d. and 1d. per B.T.U. (maximum demand system).

GENERAL STATEMENT.

| For year ending December 31st— | 1903. | 1902. |
|---|---|---|
| Total capital expended ... ... ... | £120,650 | £114,815 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 538,814 | 524,414 |
| Public lighting ... ... ... ... | 147,172 | 148,640 |
| Traction ... ... ... ... ... | nil | nil |
| Total number of units sold ... | 685,986 | 673,054 |
| Equivalent No. of 8-C.P. lamps connected | 43,164 | 39,186 |
| Number of public lamps ... ... ... | 57 arc<br>151 inc. | 57 arc<br>149 inc. |
| Maximum load in KW. ... ... ... | 556 | 510 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £13,669 | £11,062 |
| „ expenditure ... ... ... | £5,786 | £5,002 |
| „ profit ... ... ... ... | £7,883 | £6,060 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... | 4·59d. | 4·30d. |
| Public lighting ... ... ... | 2·77d. | 2·7d. |
| Traction. (A minimum amount of £1,666 received for 1903 under agreement; no supply taken by Tramways Co.) | | |

REVENUE ACCOUNT FOR YEAR ENDING DEC. 31ST, 1903.

| | |
|---|---|
| Gross revenue ... ... ... | £13,669 = 4·77d. per unit. |
| Works and distribution costs (inc. pub. ltg.) | £4,608 = 1·61d. „ |
| Total working costs ... ... ... | £5,786 = 2·02d. „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £3,480 |
| Sinking fund ... ... ... ... ... ... | 2,709 |
| Balance on year's working ... ... ... ... | 1,694 |
| Gross profit ... ... ... ... | £7,883 |

# CITY NOTES.

## Chislehurst Electric Supply Co.

THE directors report that the progress made by the company during the year 1903 was satisfactory, the number of lamps connected up to December 31st, 1903, having increased from 8,329 to 10,819, and the gross revenue from £2,365 to £2,892. Including £19 brought forward, the net revenue account shows a profit of £1,073, which, after paying interest on debentures and loans, leaves a balance of £736. The directors recommend the payment of a dividend at the rate of 3 per cent. free of income-tax, that £250 be placed to reserve fund for renewal of plant, and that the balance, £38 9s. 3d., be carried forward.

## Bromley (Kent) Electric Light and Power Co.

The directors' report to December 31st, 1903, says:—

The progress made by the company during the year has been very satisfactory, the lamp connections having increased from 35,743 to 47,030. The sale of current has increased from £7,938 to £9,843. The works have been maintained in good order and repair, and during the year large additions have been made to the generating plant, to meet the increased demand both for light and power. The result of the year's trading, including the balance of £147 10s. brought forward from last year, and after allowing for bad and doubtful debts, shows a profit of £7,143 18s., and after payment of debenture and loan interest, &c., amounting to £2,845, the amount available for dividend is £4,299. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year in October, and the directors recommend the payment of a further dividend for the last half-year at the rate of 6 per cent. per annum, making a total dividend of 5 per cent. for the year, that £1,500 be placed to a reserve fund for the renewal of plant, and that the expenses in connection with new issue of capital, amounting to £173, be written off, leaving a balance of £35 to be carried forward to the next account. During the year 4,000 new shares have been issued and subscribed for.

## Great Northern Telegraph Co., Ltd., of Copenhagen.

THE accounts for the year 1903 show that the traffic receipts were £443,968, and when the balance brought forward, and sundry receipts in respect of interest, &c., are included, there is a total revenue of £541,508. On the other hand, the working expenses were £109,404, and the balance is accounted for in the following manner:—

| | | | |
|---|---|---|---|
| Interim dividend of 5 per cent. already paid .. .. | £75,000 | | |
| Proposed final dividend of 7½ per cent. (15s. per £10 share) .. .. .. .. .. .. .. | 112,500 | | |
| Proposed bonus of 2½ per cent. .. .. .. .. | 37,500 | | |
| | £225,000 | 0 | 0 |
| Reserve and renewal fund .. .. .. .. .. .. | 55,555 | 11 | 1 |
| Pension fund of the staff .. .. .. .. .. | 5,555 | 11 | 1 |
| Remuneration to the board of directors .. .. .. .. | 2,500 | 0 | 0 |
| Dividend equalisation fund .. .. .. .. .. .. | 77,777 | 15 | 7 |
| Balance carried forward .. .. .. .. .. .. | 65,715 | 10 | 7 |

The reserve and renewal fund now stands at £1,808,798, and the renewal fund for steamers at £80,167.

## Wm. Griffiths & Co., Ltd.

THE fifth ordinary general meeting of this company was held on the 19th inst.

The CHAIRMAN, in the course of his speech, referred to the trouble which arose in connection with certain work recently carried out for the L.C.C. He stated that the total amount of concrete displaced would not have profited them to the extent of £5 on a £95,000 contract.

The SECRETARY read Mr. Stephen Sellon's report of his examination of the 26 trial openings chosen by the L.C.C., in which he points out that the concrete is up to specification, and that the fact of granite setts being embedded in certain positions, while in no wise detracting from the engineering value of the work, can only be regarded as an unfortunate accident which might occur in any contract.

## Babcock & Wilcox, Ltd.

MR. J. DEWRANCE presided at this company's meeting, held at Cannon Street Hotel on 15th inst., and said that their large profit for last year was made in the face of the keenest competition, and of a general depression in trade. It was by means of their excellent organisation and machinery that they were enabled to pay a handsome dividend, even with prices very much cut. It had been said that the board were only paying a dividend of a little more than half the actual profits, but the directors were cautious men. The engineering trade was subject to changes, and if anybody made a better boiler it might cut the company out.

The report was adopted, and a bonus of 1,000 guineas was voted to the directors in recognition of their services.

## Oriental Telephone and Electric Co.

The directors' report for 1903 says that, including £1,955 brought forward at December 31st, 1902, and deducting £5,379, the interim dividend of 3 per cent. paid November 1st last on the ordinary shares, the amount to be dealt with is ... ... ... £10,523

The directors propose to apportion this sum as follows, viz.:—

| | | |
|---|---|---|
| The payment of a dividend to December 31st, at the rate of 6 per cent. per annum, less income-tax, on the preference shares issued .. .. .. .. .. .. .. .. | £1,010 | |
| The payment of a final dividend of 3½ per cent. on the ordinary shares issued, free of income-tax, making 6½ per cent. for the year, as against 6 per cent. for the year 1902 .. | £6,276 | |
| To reserve account .. .. .. .. .. .. .. | £1,500 | |
| | | £8,786 |
| Leaving a balance to be carried forward of .. .. | | £1,737 |

In accordance with the resolution passed by the shareholders at the extraordinary general meeting held in June last, the nominal capital of the company was increased by the creation of 100,000 6 per cent. cumulative preference shares of £1 each, 50,000 of which were issued in July.

The Telephone Company of Egypt continues to extend its operations; it has entered into further contracts with the Government of H.H. the Khedive for a considerable extension of the telephone system, connecting the chief villages in the provinces of Lower Egypt, and negotiations are now in progress, by which it is hoped the company's interests in that country may be further consolidated. In order to provide that company with necessary funds, the directors have taken over during the year 4,900 of its preferred shares of £5 each, and 50 debentures of £100 each. The exchanges worked directly by the company continue to expand, and this has been particularly noticeable at the Singapore branch, at which place the directors are pleased to be able to inform the shareholders they have secured an extension of the company's license for a period of 31 years. The Indian local companies have brought increased revenues into their accounts for the year under review, and the Bombay company has paid its usual dividend of 6 per cent.; but the Bengal company, to strengthen its resources in view of cabling expenses, has reduced its usual dividend by 1 per cent., viz., to 5 per cent. In order to make a commencement with the underground cabling in India, in accordance with the conditions imposed in the new licenses obtained from the Government of India, referred to in last report, the services of a special telephone engineer were engaged to lay out plans for this cabling, and to advise the board as to the best system to adopt in that country. He has completed the surveys of Calcutta and Rangoon, and is now on his way to Singapore for the same object. It has been deemed advisable by the directors that the company, in places where long leases are unobtainable, should secure its own freehold premises, so as to avoid any possibility of having to remove its exchanges after cables have been installed. In Rangoon, premises and land have already been purchased, and the company is now in occupation. The Bombay company has recently also acquired land on a 99 years' lease on which to build suitable premises, whilst negotiations for a like purpose are now in progress at Singapore. The China and Japan Telephone Co.'s exchange at Hong Kong has made substantial progress during the year, and it is hoped that the negotiations now being carried on with the Colonial Government there will shortly result in an extended licence being granted to it. The electrical branch of the company shows a considerable increase in the volume of business transacted over that of 1902.

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**Prospectus.**—*India-rubber, Gutta-percha and Telegraph Works Co., Ltd.*—An issue of £100,000 second mortgage 4½ per cent. debentures (£100 each) at par is being made by the directors of the company. Applications are being invited from existing shareholders and debenture-holders. The new debentures will run for two years, and at March, 1906, the holders will have, jointly with the first debenture holders, the option of taking up a *pro rata* proportion of whatever issue of first mortgage debentures may be made by the company in place of the existing debentures which then mature.

**Northwich Electric Supply Co.**—At a meeting of the shareholders it was decided that, subject to the consent of Parliament, an agreement should be entered into with the Cheshire Electricity and Power Gas Co., to transfer the business of the Northwich Co. to the last-named company. The terms of the transfer as set forth, are, the repayment of the capital invested in the Northwich company, with an additional sum to make up, with the dividend paid, 7½ per cent., and a further 5 per cent. on the ascertained value.

**Calcutta Electric Supply Corporation.** — The directors recommend a dividend for the half-year ended December 31st last, at the rate of 8 per cent. per annum, making 7 per cent. for the year.

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## STOCKS AND SHARES.

Wednesday Evening.

Naturally the chief feature of the week, in financial as well as other circles, is the Budget. Owing to the non-suspension of the Sinking Fund, Consols sharply improved, because it had been thought by some that a new Chancellor of the Exchequer would be unable to resist a suspension to tide him over a difficult first Budget. This strengthening of Goschens had a sympathetic effect upon other investment stocks, which were beginning to feel a tendency to react in consequence of a slackening in business. Last week's reduction in the Bank Rate, which we noted in this column, was scarcely marked enough to induce an extension of investment trade, but there is still a strong impression that the round 3 per cent. will be announced as the Bank's minimum before long.

Prices of electrical securities show a pronounced improvement in several sections. This is more particularly the case with Telegraph varieties, where a long string of rises has occurred, while National Telephone Deferred scores as much as 5 points this week. Supply stocks and shares continue somewhat inactive, and the dealers complain with more justice than usual of neglect on the public's part. Railway and Industrial descriptions are moving with the generally harder tone of markets as a whole.

Twelve rises, ranging in extent from 5s. on shares to 6½ points on stock, give the Telegraph list a very healthy appearance. The "top note" is secured by Commercial Cable certificates, where the rise of 2½ is increased a further 4 per cent. by the deduction of the dividend on April 14th. The Anglo-American Telegraph stocks have also recovered their dividends, the Preferred having added a point to its price as well. Similar remarks apply to the Eastern Telegraph list, where the Ordinary stock has come smartly into favour, and Eastern Extensions kept them company with a ¼ advance to 11¾. Great Northerns and Indo-Europeans are each £2 up at 28 and 43½ respectively, the yields to be obtained from these shares proving attractive to buyers, while the limited nature of the market causes rapid movement. Telegraph Constructions maintain their improvement at 35½, and Globe Telegraph and Trust Ordinary rose another 5s., to 8¾, the Preference remaining at 12½. Western Telegraphs at 12½ are 5s. up, and so are Direct United States shares at 10½ Several of these rises come on top of others made last week, and in most instances the reason for improvement is the same, viz., a more general buying for investment, following upon that consideration of good yields coupled with sound security which we have been preaching for months past. As a curious coincidence, it may be noticed that the buying has been parallel with the splendid advertisement that wireless telegraphy on various systems is afforded by the Extreme Eastern struggle, and the recent negotiations between the Marconi Co. and the Post Office.

Electrical railway stocks are noticeable primarily for a two-point jump in Central London Ordinary to 93½, and some say that the coming competition of the electrified Undergrounds has already been amply discounted in the prices of the Twopenny Tube stocks. City and South London is really a little harder upon the dislocation of the tram service in South London, and Waterloo and City has not changed. Metropolitans and Districts are, if anything, a little easier. Mersey stock was sold at 6 the other day, and East London Ordinary changed hands at 4¾. Metropolitan convertible Preference is up to 7 premium, and the trio of City and South London Preferences shows a shade more strength.

Opinions seem divided as to whether or not the new London County Council loan may possibly include provision for the money due from the Marylebone Borough to the Metropolitan Electric Supply Co. The shares of the latter keep firm at 18½, and this department is singularly free from change. Edmundsons Preference are nominally ⅛ lower at 5⅞, and the Notting Hills, *ex* 6s. dividend, have been put down ½. Kensington Debenture has lost its two-point rise. Urbans remain dullish upon the prospect of the new issue of 4½ per cent. Debenture stock; we suppose the price will be fixed somewhere in the neighbourhood of 98.

How quiet the provincial list is may be judged from a short recital of some of the principal prices, Bournemouth Ordinary and Preference being 12 and 10—the 6 per cent. second Preference are 11—Oxford 5¾, Hove 8, and Folkestone 5¾. Debenture stocks in this section are very firm, Isle of Wight 4½ per cent. being quoted 103, Midland Electric Corporation 4½ per cent., 96½, Bromley (Kent) 4½ per cent., 103½, and Bournemouth 4½ per cent., 102½. Brush Preference, by the way, are ¼ lower at 15s. Cromptons have put on the same amount at 2, and India-Rubber shares advanced to 19 in sympathy with the telegraph improvement. British Aluminium Preference at 5 have risen 10s., and the Preference are quoted 8½.

British Electric Traction Preference slipped back another 5s. to 10½, the Ordinary remaining at 9. The company has just sold to the Rhondda Urban District Council the tramways within the Council's area. Anglo-Argentine Preference have recovered their dividend of 2s. 6d., the chairman's speech, quoted in these pages last week, underlining the good impression produced by the report. Mr. H. Doughty Browne, the chairman, is a member and manager of the Stock Exchange, where he has a reputation second to none for integrity and shrewd skill in the management of financial details.

To the sharp spurt in National Telephone Deferred attention has already been directed. The time for a relapse must surely be somewhere near at hand. The company's new Debenture stock is 3¾ premium, and the old 4 per cent. is up a point at 102. The Third Preference shares at 5½ have gained the fraction. Other Telephone varieties exhibit no alteration on the week.

Babcock & Wilcox Ordinary are 3, the same as Willans & Robinson Ordinary. The Preference shares of the former remain about 30s., while Willans Preference have hardened a little to 4¼, for the £5 shares.

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**Bank Rate Altered.**—The Bank rate yesterday was further reduced from 3½ to 3 per cent.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share, ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations April 18th. | Closing Quotations April 20th. | Business done week ended April 20th, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 98 —102 | 98 —102 | 98¾ | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2⅛ — 3⅛ | 2⅛ — 3⅛ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | 70 — 80 | .. — .. | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 48 — 51 | 48 — 51 xd | .. | .. |
| 3,105,880 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 91 — 93 | 92 — 94 xd | 93 | 91¾ |
| 3,105,880 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 7⅛ — 7⅜ | 7⅛ — 7⅜ | .. | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | .. | 4⅛ — 5⅛ | 4⅛ — 5⅛ | .. | .. |
| 18,333,300$ | Commercial Cable | $100 | 8 % | 8 % | .. | 175 —180 | 175 —185 xd | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 90 — 92 | 91 — 93 | .. | .. |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6¾% | .. | 7⅛ — 8⅛ | 7⅛ — 8⅛ | 8½ | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15⅛ — 16⅛ | 15⅛ — 16⅛ | .. | .. |
| 12,931 | Direct Spanish Telegraph | 5 | 4 % | 4 % | .. | 2⅛ — 3⅛ | 2⅛ — 3⅛ | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 30,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | .. | 10 — 10½ | 10⅛ — 10⅜ | 10½ | 10⅝ |
| 85,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red. | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | .. | 120 —125 | 121 —126 xd | 125 | 121 |
| 1,955,555 | Do. 3½ % Pref. Stock | 100 | .. | .. | .. | 86 — 89 | 85 — 88 xd | 87 | 86 |
| 1,534,545 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 104 —107 | 104 —107 | .. | .. |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 11¼ — 11¾ | 11¼ — 12 | 11¾ | 11 11/16 |
| 820,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 103 —106 | 103 —106 | 103 | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000 | 25 | .. | .. | .. | 100 —103 | 101 —104 | .. | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 6¼% | .. | .. | 8½ — 8¾ | 8¾ — 9 | 8⅞ | 7⅞ |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 12¼ — 12¾ | 12¼ — 12¾ | 12⅞ | 12⅝ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 25 — 26 | 27 — 28 | 25⅝ | .. |
| 58,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 40 — 43 | 42 — 45 | 44 | 43½ |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 1,983,333 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 103 —105 | 103 —105 | 104½ | 103 |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 86 — 88 | 91 — 93 | 92½ | 86¾ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 10 — 12 | 10 — 12 | 11⅛ | 11⅛ |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 10 — 12 | 10 — 12 | 10⅞ | 10⅞ |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 4⅞ — 5⅛ | 5 — 5⅛ | 5 5/16 | 5 1/16 |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 98⅜ | 98 |
| 600,000 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 100 —102 | 101 —103 | 103 | 101¼ |
| 179,313 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6 % | 6¼% | 1 1/16 — 1 1/16 | 1 1/16 — 1 1/16 | 1 | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,889 | Reuter's | 8 | 5 % | .. | .. | 6¾ — 7⅛ | 6¾ — 7⅛ | .. | .. |
| 3,808 | Submarine Cables Trust | Certs. | .. | .. | .. | 118 —123 | 117 —122 xd | 121⅞ | 120 |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 5⅛ — 6 | 5⅛ — 6 | 5⅜ | 5⅛ |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | 5 | .. |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | 2 % | .. | 5 — 6 | 5 — 6 | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel. | 100 | .. | .. | .. | 97 — 100 | 97 —100 | .. | .. |
| 267,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | .. | 12 — 12½ | 12¼ — 12⅝ | 12⅝ | 12⅛ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | 100½ | .. |
| 88,321 | West India and Panama Telegraph | 10 | .. | .. | .. | 3/16 — ¼ | 3/16 — ¼ | 1/16 | .. |
| 34,568 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 5⅞ — 6⅛ | 5⅞ — 6⅛ | 6⅛ | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 4⅛ — 5⅛ | 4⅛ — 5⅛ | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 4 — 5 | 4⅛ — 5⅛ | .. | .. |
| 800,000£ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 90 — 95 | 90 — 95 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 8¾ — 9⅛ | 8¾ — 9⅛ | 9 3/16 | 8 15/16 |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 10⅛ — 10⅜ | 10 — 10⅛ | 10 1/16 | 10⅛ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 116 —119 | 114 —117 | 117⅛ | .. |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 6 — 6⅛ | 5⅞ — 6⅛ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5⅛ — 5⅜ | 6⅛ — 5⅜ | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 102 —107 | 102 —107 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | .. | .. | 3/16 — ¼ | 3/16 — ¼ | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | Nil | Nil | .. | ⅛ — ¼ | ⅛ — ¼ | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | .. | ⅞ — 1⅛ | ⅞ — 1 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 72 — 77 | 72 — 77 | 72½ | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | .. | 10½ — 11½ | 10½ — 11½ | 11 1/16 | 10½ |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅛ | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 104 —108 | 104 —108 | 104½ | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 90 — 93 | 92 — 95 | 94 | .. |
| 494,093 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 98 —101 | 98 —101 | .. | .. |
| 494,993 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 85 — 88 | 85 — 88 | 87 | .. |
| 1,380,000 | City and South London Railway | Stock | 2 % | 3½% | 2¾% | 49 — 52 | 49 — 52 | 51½ | .. |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 3 | 7½% | 5 % | .. | 1⅞ — 2 | 1⅞ — 2⅛ | .. | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261 | 5 | Nil | Nil | .. | 0 — ⅛ | 0 — ⅛ | .. | .. |
| 17,139 | Do. do. "A" shares, 01—017,139 | 5 | Nil | Nil | .. | ⅛ — 1⅛ | ⅛ — 1⅛ | .. | .. |
| 344,023£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 72 — 77 | 72 — 77 | .. | .. |
| 100,000£ | Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 74 — 79 | 74 — 79 | .. | .. |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | .. | 1½ — 1⅝ | 1½ — 1⅝ | 1 1/16 | 1 1/32 |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | 2 | .. | .. | .. | 2⅛ — 3 | 2⅛ — 3 | .. | .. |
| 82,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9 — 9½ | 9 — 9½ | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 98 — 98 | 98 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 15 % | 11½ — 12⅛ | 11½ — 12⅛ | 11¾ | 11⅝ |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18 — 19 | 18½ — 19½ | 18¾ | .. |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | .. | 4 13/16 — 4 15/16 | 4 13/16 — 4 15/16 | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 37,350 | Telegraph Construction and Maintenance. | 12 | 20 % | 20 % | 20 % | 34 — 37 | 34 — 37 | 35½ | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3⅛% | 3⅛% | 89 — 92 | 89 — 92 | .. | .. |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3½ per cent. (April 14th, 1904).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years | | | Closing Quotations April 13th. | Closing Quotations April 20th. | Business done week ended April 20, 1904. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1901. | 1902. | 1903. | | | Highest. | Lowest |
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord... .. .. | £1 | .. | .. | .. | ⅞ — ⅞ | ⅞ — ⅞ | .. | .. |
| 50,000 | Do. 7 % Pref. .. .. .. .. .. | £1 | .. | .. | .. | 1⅛ — 1⅛ | 1⅛ — 1⅛ | 1 1/16 | .. |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. .. | £100 | .. | .. | .. | 113 — 116 | 113 —116 | .. | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | £5 | 8 % | 8 % | 10 % | 10¾ — 11 | 10¾ — 11 | .. | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | £5 | .. | .. | .. | 10¼ — 10⅝ | 10¼ — 10⅝ | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. .. | £100 | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. .. | £5 | 10 % | 10 % | 8 % | 7 — 7⅛ | 7 — 7⅛ | .. | .. |
| 70,000 | Do. do. do. 4½% Cum. Pref. .. | £5 | .. | .. | .. | 5⅛ — 5⅛ | 5⅛ — 5⅛ | 5 7/16 | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. .. | £5 | .. | .. | .. | 4⅛ — 5 | 4⅛ — 5 | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. .. | £5 | .. | .. | .. | 4⅛ — 5 | 4⅛ — 5 | .. | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. .. | £100 | .. | .. | .. | 102 —104 | 102 —104 | 103½ | 103 |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | £5 | 4 % | 4½% | 5½% | 6 — 6½ | 6 — 6½ | .. | .. |
| 150,000£ | Do. do. % Deb. Stock Red. .. .. .. .. | Stock | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 .. | £10 | 5 % | 5 % | 5 % | 10⅜ — 10⅝ | 10⅜ — 10⅝ | .. | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | £10 | .. | .. | .. | 13 — 14 | 13 — 14 | 13⅜ | 13⅛ |
| 400,000£ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. .. | .. | .. | .. | .. | 121 —126 | 121 —126 | 124½ | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | £100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 40,000 | County of London & Brush Prov. Electric Lighting, Ord. 1—40,000.. | £10 | 4 % | 4 % | 4 % | 7 — 8 | 7 — 8 | 7 1/16 | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000.. | £10 | .. | .. | .. | 11 — 12 | 11 — 12 | .. | .. |
| 400,000£ | Do. do. 4½% Deb. Stock .. .. .. .. .. | .. | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 99 —102 | 99 —102 | 100½ | 100 |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. .. | £5 | 7 % | 7 % | .. | 5⅞ — 6¼ | 5⅞ — 6¼ | 6 1/16 | .. |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 5⅞ — 6¼ | 5⅞ — 6 | 5⅞ | 5⅞ |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | £100 | .. | .. | .. | 104 —107 | 104 —107 | 106½ | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | £5 | 10 % | 10 % | 12½ | 11 — 12 | 11 — 12 | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 103 —106 | 101 —104 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | £3 | .. | .. | .. | 1 — 1½ | 1 — 1½ | 1 1/16 | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | £5 | .. | .. | .. | 4¼ — 5 | 4¼ — 5 | .. | .. |
| 350,000£ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 94 — 97 | 94 — 97 | .. | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | £10 | 6½% | 7½% | 8½% | 18 — 19 | 18 — 19 | 18 1/16 | 18⅛ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | £5 | .. | .. | .. | 5¼ — 5⅜ | 5¼ — 5⅜ | .. | .. |
| 290,000£ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 109 —113 | 109 —113 | .. | .. |
| 250,000£ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 95 — 98 | 95 — 98 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. | £10 | 6 % | 6 % | 6 % | 13 — 14 | 12½ — 12⅝ xd | .. | .. |
| 50,000 | Do. do. 4 % First Mort. Debs. .. .. .. | £100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. .. | £5 | 14½% | 14½% | 14½% | 14 — 15 | 14 — 15 | .. | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | £5 | .. | .. | .. | 8 — 9 | 8 — 9 | .. | .. |
| 150,000£ | Do. do. do. 3½% Deb. Stock Red .. | £100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | £5 | .. | 2½% | 4 % | 3 — 3½ | 3 — 3½ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 85 — 90 | 85 — 90 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. .. | £5 | .. | 1¾% | 3 % | 3 — 3½ | 3 — 3½ | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. | £5 | .. | .. | .. | 4⅜ — 4½ | 4⅜ — 4½ | 4⅜ | .. |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 4⅜ — 5 | 4⅜ — 5 | 4½ | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. .. | £5 | 10½% | 12 % | 13½% | 12½ — 13½ | 12½ — 13½ | 13 | 12½ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 6 — 6½ | 6 — 6½ | .. | .. |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS. Wednesday, April 20th.

| | CHEMICALS, &c. | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|---|
| a | Acid, Hydrochloric .. .. | per cwt. | 5/- | .. |
| a | „ Nitric .. .. .. .. | per cwt. | 22/- | .. |
| a | „ Oxalic .. .. .. .. | per cwt. | 32/- | .. |
| a | „ Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| a | Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a | Ammonia, Muriate (crystal) .. | per ton | £38 10 | .. |
| a | „ „ .. .. .. | per ton | £30 | .. |
| a | Bleaching powder .. .. .. | per ton | £4 10 | .. |
| a | Bisulphide of Carbon .. .. | per ton | £16 | .. |
| a | Borax .. .. .. .. .. | per ton | £13 | .. |
| a | Benzole (90 %) .. .. .. | per gal. | 7/- | .. |
| a | „ (50/90 %) .. .. .. | per gal. | 5/6 | .. |
| a | Copper Sulphate .. .. .. | per ton | £21 10 | 30/- dec. |
| a | Lead, Nitrate .. .. .. | per ton | £24 | .. |
| a | „ White Sugar .. .. | per ton | £31 | .. |
| a | „ Peroxide .. .. .. | per ton | £27 10 | .. |
| a | Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| a | Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| a | Potash, Bichromate, in casks .. | per lb. | 8d. | .. |
| a | „ Caustic (75/80%).. .. | per ton | £24 | .. |
| a | „ Bisulphate .. .. | per ton | £35 | .. |
| a | Shellac .. .. .. .. | per cwt. | 225/- | 7/- inc. |
| a | Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a | Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a | „ Recovered .. .. | per ton | £5 10 | .. |
| a | „ Lump .. .. .. | per ton | £5 | .. |
| a | Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a | „ Crystals .. .. .. | per ton | £8 | .. |
| a | „ Bichromate, casks.. .. | per lb. | 2½d. | .. |
| | **METALS, &c.** | | | |
| b | Aluminium Ingots, in ton lots .. | per ton | £130 | .. |
| b | „ Wire, in ton lots .. | per ton | £168 | .. |
| b | „ Sheet, in ton lots .. | per ton | £166 | .. |
| p | Babbitt's metal ingots .. .. | per ton | £48 to £130 | .. |
| c | Brass (rolled metal 2" to 12") basis | per lb. | 6¾d. | .. |
| c | „ Tube (brazed) .. .. | per lb. | 8¾d. | .. |
| c | „ „ (solid drawn).. .. | per lb. | 7¾d. | .. |
| c | „ Wire, basis.. .. .. | per lb. | 7d. | .. |
| c | Copper Tubes (brazed) .. .. | per lb. | 9½d. | .. |
| c | „ „ (solid drawn) .. | per lb. | 9¾d. | .. |
| g | Copper Bars (best selected .. | per ton | £74 | £2 inc. |

| | METALS, &c. (*continued*). | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|---|
| g | Copper Sheet .. .. .. | per ton | £74 | £2 inc. |
| g | „ Rod .. .. .. .. | per ton | £74 | £2 inc. |
| e | „ (Electrolytic) Bars .. | per ton | £64 | .. |
| e | „ „ Sheets .. | per ton | £80 | .. |
| e | „ „ Rod .. | per ton | £74 | .. |
| e | „ „ H.C. Wire | per lb. | 8d. | .. |
| f | Ebonite Rod .. .. .. | per lb. | 3/8 | .. |
| f | „ Sheet .. .. .. | per lb. | 8/- | .. |
| n | German Silver Wire .. .. | per lb. | 1/6 | .. |
| h | Gutta-percha fine .. .. .. | per lb. | 8/- | .. |
| h | India-rubber, Para fine .. .. | per lb. | 4/8½ to 4/10½ | inc. |
| i | Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i | „ Pig (Cleveland warrants) | per ton | 44/7 | 1d. dec. |
| i | „ Forgings, according to size | per ton | From £11 | .. |
| i | „ Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i | „ Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g | Lead, English Ingot .. .. | per ton | £12 10 to £12 12 6 | 2/6 inc. |
| g | „ „ Sheet .. .. | per ton | £13 | .. |
| m | Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g | Mercury .. .. .. .. | per bot. | £8 5 | .. |
| d | Mica (in original cases) small .. | per lb. | 6d. to 1/9 | .. |
| d | „ „ „ medium | per lb. | 2/6 to 4/- | .. |
| d | „ „ „ large .. | per lb. | 4/6 to 8/6 | .. |
| p | Phosphor Bronze, plain castings | per lb. | 1/- to 1/2½ | .. |
| p | „ rolled bars & rods | per lb. | 1/- to 1/3 | .. |
| p | „ „ strip & sheet | per lb. | From 1/1 | .. |
| o | Platinum .. .. .. .. | per oz. | £4 | .. |
| p | Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| i | Steel, Magnet, acc'd'g to desc'p'n | per ton | £68 | .. |
| i | „ „ in bars .. .. | | £15 to £40 | .. |
| g | Tin, Block .. .. .. .. | per ton | £128 10 to £129 10 | £1 inc. |
| g | „ Foil .. .. .. .. | per lb. | 1/6 | .. |
| n | „ Wire, Nos. 1 to 16 .. .. | per lb. | 1/7 | .. |
| p | White Anti-friction Metals— | | | |
| | "White Ant" brand .. | per ton | £42 to £62 | .. |
| j | Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| j | „ 6 lea. Flax .. .. .. | per lb. | 5¾d. | .. |
| j | „ 8 ply 10 lbs. Russian | per lb. | 4 1/2d. | .. |
| j | „ 10 lbs. Russian, single .. | per lb. | 4¼d. | .. |
| j | „ 180 lbs. Jute rove | per ton | £11 | .. |
| k | Zinc, Sh't (Vieille Montagne bnd.) | per ton | £25 5 | 10/- inc. |

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| | Locality. | Week ending | Receipts for the week. | | No. wks. | Total to date. | | Miles open. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | £ | £* | | £ | £* | | * |
| Tram. | Aberdeen .. .. | Apr. 16 | 1,207 | +336 | 46 | 55,286 | +11,243 | 10 | — |
| | Birmingham .. | „ 15 | 5,227 | — 47 | 16 | 82,610 | + 4,208 | 3½ | — |
| | Bournemouth .. | „ 13 | 1,148 | —341 | 52 | 52,445 | — | 10½ | — |
| | Blackburn .. .. | „ 15 | 774 | —317 | 3 | 2,904 | + 31 | 13½ | — |
| | Blackpool .. .. | „ 14 | 533 | —1107 | 2 | 1,979 | — 26 | 8½ | — |
| | „ —Fleetw'd | „ 16 | 267 | —428 | 16 | 3,671 | — 344 | 7½ | — |
| | „ —Lytham | „ 7 | 601 | — | 23 | 3,886 | + 3.307 | 7½ | — |
| | Bolton .. .. | „ 17 | 1,810 | — 57 | 3 | 4,796 | — 295 | 25 | — |
| | Bradford .. .. | „ 9 | 4,805 | +1004 | 1 | 6,215 | + 10 | 76 | — |
| | Brighton .. .. | „ 10 | 980 | — | — | 1,462 | — | 7½ | — |
| | Bristol .. .. | „ 15 | 4,725 | —919 | — | — | — | 28 | — |
| Co. | Devonport .. | „ 8 | 561 | + 58 | 14 | 6,494 | + 922 | 5 | — |
| | Dudley—Sto'rb'ge | „ 8 | 1,173 | +892 | 14 | 10,722 | + 798 | 18½ | — |
| | Gateshead .. | „ 8 | 990 | + 49 | 14 | 12,201 | + 703 | 10½ | + ¾ |
| Trac. | Gr'n'k—Pt. Glsgw | „ 8 | 489 | + 16 | 14 | 6,510 | + 613 | 7½ | — |
| | Hartlepool .. | „ 8 | 319 | + 33 | 14 | 3,518 | + 384 | 6½ | +2 |
| | Oldham—Ashton | „ 8 | 641 | — 16 | 14 | 7,071 | — 333 | 8 | — |
| Elec. | Potteries .. .. | „ 8 | 1,903 | +315 | 14 | 22,167 | + 1,873 | 28½ | — |
| | Southport .. .. | „ 8 | 413 | +106 | 14 | 3,555 | + 379 | 5½ | — |
| & | South Staffs. .. | „ 8 | 1,075 | +286 | 14 | 10,609 | + 161 | 21½ | — ¾ |
| | Swansea .. .. | „ 8 | 613 | + 70 | 14 | 6,562 | + 288 | 5½ | — |
| Rly. | Wolverhampton.. | „ 8 | 539 | +145 | 14 | 4,817 | — 53 | 10½ | +8 |
| | Yorks. Wool Dist. | „ 8 | 810 | +576 | 14 | 7,402 | + 3,097 | 6 | — |
| | Miscellaneous .. | „ 22 | 3,415 | — | 14 | 29,155 | — | — | — |
| | Burnley .. .. | „ 9 | 971 | — 57 | — | — | — | 10·15 | +2·4 |
| | Burton-on-Trent .. | „ 17 | 321 | — | 37 | 12,320 | — | 8½ | — |
| | Cardiff .. .. | „ 9 | 2,194 | +321 | — | 2,838 | — 130 | 1 | — |
| | Chatham & District | „ 14 | 579 | — 77 | 15 | 7,782 | + 1,990 | 8·58 | — |
| | Cork .. .. .. | „ 14 | 434 | — 44 | 15 | 5,904 | — 190 | 9 | — |

| | Locality. | Week ending | Receipts for the week. | | No. wks. | Total to date. | | Miles open. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | £ | £* | | £ | £* | | * |
| | Dover .. .. | Apr. 16 | 202 | — 29 | 15 | 2,700 | — 151 | 3 | — |
| | Dublin .. .. | „ 15 | 4,573 | — 545 | 16 | 65,768 | + 432 | 47 | + ½ |
| | East Ham .. .. | „ 16 | 706 | — 19 | — | 1,812 | + 54 | 5 | + ¼ |
| | Glasgow .. .. | „ 16 | 13,997 | +770 | 46 | 624,690 | +57,597 | 69½ | +5 |
| | Halifax (2 weeks) .. | „ 6 | 3,103 | +731 | 1 | 1,672 | + 399 | 33 | +2½ |
| | Huddersfield .. | „ 16 | 1,136 | +373 | 1 | — | — | 28 | — |
| | Hull .. .. .. | „ 16 | 2,047 | +261 | 2 | 5,003 | + 107 | 12¼ | +1½ |
| | Ilkeston .. .. | „ 13 | 119 | — | — | — | — | 3½ | — |
| | Ipswich .. .. | „ 16 | 899 | — | 2 | 1,126 | — | 9 | — |
| | Isle of Thanet .. | „ 16 | 424 | —201 | 15 | 4,173 | — 437 | 10½ | — |
| | Leeds .. .. .. | „ 16 | 5,124 | —719 | — | 17,736 | + 835 | 41 | — |
| | Liverpool .. .. | „ 9 | 10,463 | + 50 | 15 | 143,583 | + 3,272 | 108 | — |
| | London C. C. .. | „ 16 | 10,465 | +1465 | 2 | 25,829 | + 5,127 | 32½ | —7 |
| | Manchester .. .. | „ 16 | 11,367 | —642 | 2 | 23,494 | — 578 | 131½ | — |
| | Newcastle .. .. | „ 16 | 3,396 | + 99 | — | — | — | 17 | — |
| | Portsmouth .. .. | „ 16 | 1,678 | —292 | — | 4,847 | + 194 | 14½ | — |
| | Salford .. .. | „ 11 | 3,771 | —292 | — | 6,540 | — 284 | 30 | — |
| | Sheffield .. .. | „ 17 | 4,392 | —283 | 3½ | 15,084 | — 671 | 32½ | +4½ |
| | Southampton .. | „ 14 | 915 | —129 | — | — | — | 25½ | — |
| | Southend-on-Sea .. | Mar. 10 | 211 | — 3 | 52 | 15,648 | + 2,247 | 6 | — |
| | Sunderland .. .. | Apr. 17 | 1,119 | — 17 | 3 | 2,859 | — 263 | 20 | +8 |
| | Tyneside .. .. | „ 13 | 281 | —2·2 | 15 | 4,308 | + 523 | 8·9 | + ·4 |
| | West Ham .. .. | „ 14 | 691 | — | 7 | 2,805 | — | 4·56 | — |
| | Wolverhampton .. | „ 13 | 578 | + 90 | — | — | — | 7·563 | — |
| | Cen. London Rly. .. | „ 16 | 6,597 | — 857 | 16 | 111,392 | — 538 | 6 | — |
| | City & S. Lon. Rly. | „ 17 | 2,704 | —360 | 16 | 49,644 | — 1,171 | 6½ | — |
| | Dublin—Lucan Rly. | „ 17 | 102 | — 55 | 16 | 1,505 | + 48 | 6½ | — |
| | L'pool Overh'd Rly. | „ 17 | 1,629 | —194 | 16 | 24,742 | + 155 | 6½ | — |
| | Mersey Railway .. | „ 16 | 1,591 | +183 | 15 | 21,896 | + 5,357 | 4½ | — |

* Compared with the corresponding period of 1903.

## INSTITUTION OF ELECTRICAL ENGINEERS.

### ELECTRIC WINDING ENGINES.

By Maurice Georgi.

(*Abstract of Paper read at Glasgow on February 13th, 1904.*)

Up to the present time in this country electrical winding engines are practically unknown, although on the Continent, especially in the mines of Silesia and Westphalia, they have during the last few years made rapid headway. The modern steam winding engine is well adapted to all the demands of the service; it nevertheless absorbs an immense quantity of steam, as the effort is never constant, and therefore the admission in the cylinders is essentially varying. For instance, in starting his machine the driver has to open his stop valve completely, giving full admission in order to shorten the acceleration period. After a certain number of turns of the engine the haul is finished, and he has to stop his machine by using his brakes or giving counter steam to the cylinders; thus the whole of the kinetic energy of the system is lost in the brakes. Should a load be lowered, as is often the case, we possess no means of turning to any practical use the work done by the engine, the liberated energy having to be constantly absorbed by the brakes.

If we now turn to an electric winding engine we find that its first advantage is to diminish very considerably the coal consumption, which can be brought down to about one-third of its original value if a modern generating plant is adopted. Steam turbines, superheated steam, variable expansion, and gas engines fed by producer gas cannot be utilised by the present winding engines, but all are now at our disposal, and as it is now possible to maintain an absolutely constant load on our machinery, an entirely new set of conditions is arrived at in the arrangement of our power-house plant.

Considering that the work done by winding machinery is of the most intermittent character, the torque to be overcome at the beginning being sometimes more than double that during the haul (owing to acceleration), it will be necessary, should no special contrivance be used, to calculate the steam engine driving our dynamos to enable it when starting up to overcome the corresponding torque; and, on the other hand, it must work with an economical admission during the haul and whilst the winding machinery is at rest. These conditions are, as a rule, incompatible, so that engineers have been led to invent means by which energy should be accumulated whilst the winding engine is at rest, this energy being given up whilst working, so as to have as far as possible a constant admission in the cylinders, and consequently a high working factor. If we use continuous current our mind is at once led in the direction of a storage battery. This system, so far as theory is concerned, gives a perfect compensation should the battery be properly calculated, but it does not do away with the starting resistance, although the machine can be started in an economical way by a complicated battery subdivision, the motor being grouped on to various combinations of cells.

The disadvantages of such a method of operating are at once apparent; the complicated and delicate electrical contrivances, together with the inherent disadvantages of storage batteries, more than compensate for any gain which may be obtained in efficiency of operation.

On the Continent numerous electric winding engines, and some of considerable importance, have been designed after this system, but have not proved themselves suitable for the operations they had to perform.

There are fortunately, however, other methods, using mechanical means of compensation, which achieve the same purpose by means of massive fly-wheels coupled on our prime movers.

As far as safety is concerned, the conditions that will have to be realised are:—

1. The utmost security of working, as winding engines are not only used for the extraction of minerals, but also for transporting men.

2. The speed of the machine will have to be regulated independently of the load—that is to say, independently of the current in the armature, and with the utmost possible economy.

These conditions, especially the second, can be said to have been solved in a satisfactory manner by a new system of compensation discovered by Herr Ilgner, of the Donnersmarckhütte.

The system is based on the well-known fact that a direct current shunt-wound motor with field of constant intensity, and fed by an independent source, will run when an E.M.F. is applied to the armature terminals with a speed directly proportionate to the voltage, and to the number of turns on the armature. Therefore, if we arrange a continuous-current dynamo with independent excitation, whose voltage can be regulated from zero to a positive or negative maximum by means of a field resistance, a motor coupled on the same circuit, and having a constant field, will run at a speed varying between zero and a positive or negative maximum.

The starting of the machine is thus most economical, and at any time the power consumed is only equal to the product of the voltage by the current.

To compensate the variations of power required, Mr. Ilgner adopts the following device:—

The current taken from the supply drives a converter, composed of a motor, a continuous current dynamo, and a heavy fly-wheel.

An automatic slipping device is fixed to the motor by means of which, should the dynamo call for power, and, therefore, the current in the motor have a tendency to augment, the slip is increased, the fly-wheel giving up kinetic energy. The reverse operation occurs if the dynamo gives no more power, the current in the motor then being used only to bring the speed of the fly-wheel from its present speed to its maximum. The weight and speed of fly-wheel are to be calculated so that for a given slip the output of the motor should remain the same.

Thus the winding engine, as far as the supply station is concerned, may be considered as an ordinary motor of constant output, and treated accordingly.

That the speed is practically independent of the load lies in the fact that we have to do with a shunt motor. This is a most important advantage, possessed by no steam or electrically-driven engine, that to one position of the controller lever corresponds but one speed.

Another advantage is that the machine can be always very economically stopped in the following manner:—

Let us suppose that the machine is running at full speed corresponding to the maximum voltage; if we draw the controller lever backwards the voltage of the dynamo will drop, but that of the motor remains the same, so that current will go from motor to dynamo. The system is thus economically stopped, as the recuperated energy is sent from the dynamo through the fly-wheel and motor back into the supply mains. The brakes are absolutely useless excepting for holding up the machine.

If we turn to the actual economy of the system, we find it in no way inferior to that of the very best of other known methods. No starting resistances are used, the energy recuperated at any time is sent back into the line, and the working factor of the fly-wheel is nearly equal to unity.

The current from the dynamo of the converter is carried, without interposition of any switch or fuse, to the winding motor. In this manner no sudden stoppage of the electric supply to the winding motor is likely to occur; the safety appliances are practically useless, as the machine cannot be overloaded, and a short-circuit due to defective cablage is always noticeable immediately. The field-magnet exciting current is produced by a small dynamo on the shaft of the converter.

Now, it is of absolute necessity that the voltage at the terminals of this motor should remain the same whatever its speed may be. To produce this, we place a very small dynamo, series wound, next to the exciting dynamo. The current of this auxiliary dynamo passes through windings on the poles of the dynamo, having a demagnetising effect; thus the fall of speed of converter will have no effect on the voltage, as the loss in turns will be compensated by a stronger field, the current in the auxiliary dynamo diminishing.

The mechanism is so designed that it is absolutely unnecessary for the attendant to pay any attention to slowing down his machine; the apparatus does it for him, and also stops it should he be unable to do so. Moreover, the attendant cannot start too suddenly.

The maximum speed can never be exceeded; a special speed controller is therefore utterly useless.

The sudden stoppage of electric energy from the main does not jeopardise in any way the good working of the engine, as the kinetic energy contained in the fly-wheel is more than sufficient to complete several hauls.

The remainder of the paper is taken up with detailed calculations relating to examples from practice, and estimates of the capital and working costs of the electric system, as compared with the existing system. The capital outlay for electric plant in one case would be £10,000, compared with £8,450 for steam plant; the working costs would be £1,115 per annum, compared with £1,594 for steam, showing a saving of 30 per cent., in a Scotch colliery. A much greater economy would be effected at a Welsh colliery, owing to the greater value of the fuel.

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In the discussion on March 8th, Mr. W. B. Sayers said that he noticed Mr. Georgi referred to the arrangement described in his paper as a new discovery; but he did not see how it differed essentially from the Ward-Leonard arrangement. It seemed to him that there were serious matters to be taken into consideration before using a fly-wheel in this way. With a heavy fly-wheel coupled rigidly, as it appeared to be, to the generator the consequences might be very serious indeed if they got a short-circuit on the generator. It might be necessary, instead of coupling the fly-wheel direct, to couple it through some device which would break if the strain exceeded a given value. At the beginning of the haul, when the generator was only slightly excited, there would be a call for double current. These conditions were somewhat trying for commutation. There were some paragraphs in the paper which he did not understand. Why was it "absolutely necessary that the voltage should remain constant"? It should, of course, remain so within, say, 15 or 20 per cent. The author's figures showed a saving brought about chiefly by saving two-thirds the total fuel. His experience was that the stuff burnt at collieries would hardly be worth carrying away for sale.

Mr. Sam Mavor said he thought the system advocated by Mr. Georgi was too complicated. The introduction of so many links, each one more or less liable to derangement, between the engine and winding drum, was the most obvious disadvantage of the system proposed, and the saving had to be very substantial indeed to warrant a departure from the simplest method of conducting an operation so critical as main shaft winding.

Mr. J. Brash said that winding in collieries was not a thing for electrical engineers to tackle. As far as cost was concerned, he did not think there would be any saving. In Mr. Georgi's comparison of the capital and running costs of a steam installation with an electrical one, he did not allow the same margin of power in the latter as in the former. This was an important matter, because the plant might be called upon to develop two or three times the power given. Mr. Brash severely criticised the figures given in the paper, and said that he was of opinion that, useful as electricity might be made in connection with coal mines, it was neither economical or

safe to use it for winding. If further economy in fuel was to be looked for in winding engines, some arrangement such as that proposed by Prof. Rateau, utilising the exhaust steam to work turbines, would be found to solve the problem without sacrificing either reliability or efficiency.

Mr. H. A. Mavor said that he thought they ought to convey to Mr. Georgi their thanks for bringing this subject before them. Whatever might be their opinion as to the utility of the scheme, no doubt it was of the highest importance to them to consider such questions. With regard to the proposals described in the paper, it appeared to him that there was no reason why the steam engine should not run at a constant speed and drive the fly-wheel. A very serious point which altogether vitiated the calculations with regard to comparative economy was the assumption that the engine would work 16 hours a day for winding. Of course, an eight hours' shift was the more usual arrangement. It appeared from the letterpress of the paper that the saving effected was comparatively insignificant, and that the economy of the system depended upon the storage of energy in the fly-wheel. There were other possible means of dealing with the matter which were worthy of consideration.

## COAL CUTTING MACHINES.

The Chairman then called on Mr. Sam Mavor to deliver a short informal address on "Coal-Cutting Machines."

Mr. Mavor said that the adoption of such machines had been very limited only. The reason for this seemed to be partly that the prices obtained for coal provided a sufficient margin of profit to disincline coalowners from any over-eagerness to adopt new methods of working, and partly owing to the fact that in the thick seams being mined in most of the coalfields in this country, the advantages of mechanical coal cutting were relatively less than in the thinner seams which were being extensively opened out. In America, however, where thick seams were the rule, the development of machine mining had been more rapid, and in that country there were over 3,000 coal cutting machines at work, as against about the same number of hundreds of coal cutters in Britain; even when allowance had been made for the fact that many of the American machines were of a light and portable type, it was still true that in America about 25 per cent. of the coal was mechanically cut, while in Britain only about 2 to 3 per cent. of the coal mined was cut with machines.

The coal cutter had many advantages over the older method of hand cutting. It was more economical, in respect of lessening the number and length of roads and the amount of timbering necessary for the proper working of the coal mine; it greatly decreased the risk of subsidence of coal at the face, which was the most prolific cause of fatalities in coal mines, because by rendering the working face practically straight it facilitated systematic and regular timbering. As a matter of fact, the insurance premium for employers' liability insurance was reduced by one-half where machines were used. The machine gave a greater yield of coal for a given oncost. Another important point was that there was a growing scarcity of skilled hewers, and this scarcity, which had become acute in many parts of England, was met by the mechanical coal cutter. Machines had been adopted in a great many cases where hewers capable or willing to undercut in hard material could not be got, and where there would have been no alternative but shutting up the mine if machines had not been available.

The three best known types of coal cutting machines were the disk type, the chain type, and the bar type. The last named was the machine which he was inclined to favour for most kinds of work. This machine was perfectly safe, because the working parts were enclosed in a flame-tight case.

Mr. Wm. M'Whirter said that it seemed to him that the bar machine was too heavy and not portable enough from the colliery manager's point of view. Some time ago he had had to assist in carrying out some experiments with a coal cutter constructed on the principle of a band saw, but owing to the band sagging in the middle they had not been very successful. They could never get enough tension on the chain which formed the band.

Mr. J. Brash said that the question was an important one. In the Lanarkshire coal field the thicker seams were being worked out, and the thinner seams, from 15 in. to 18 in. in thickness, were now being worked. With regard to the amount of power required for coal cutting, it was at first supposed that 14 H.P. was sufficient, and this was about the actual power required when the machine was running under normal conditions; but the hard usage incidental to machine coal cutting entailed a large surplus of power, and machines were now fitted with motors of 25 to 35 H.P., capable of giving increased output for short periods. The power required depended entirely on the different conditions met with in practice, on the hardness of the holding and the speed of cutting. It was an important matter that the electrician and the mining engineer should work hand in hand, as only in that way would electric coal cutting be brought to a satisfactory issue.

Mr. Sam Mavor, in reply, said that with the disk type of machine the power expended was about 24 H.P., whereas the bar machine took about 16 H.P., or about two-thirds of the power required by the disk machine. In the report of a month's work of a bar machine recently installed for a Lanarkshire coal-owner, the number of tons cut was given as 2,400, the power expended being about ·37 of a unit of electrical energy per ton cut, or less than ½d. per ton, in a coal seam about 2 ft. 8 in. thick. It was necessary that the machine should have considerable weight in order that it might sit down properly to its work. The success of mechanical coal-cutting depended greatly upon the management of the pit. It was found, as a general rule, that coal-cutters were driven much harder in Scotland than in England.

## DYNAMO AND MOTOR TESTING.

By PROF. C. F. SMITH, Wh.Sc.

(*Abstract of Paper read Thursday, March 3rd, 1904, before the Civil and Mechanical Engineers' Society*)

The field covered by the title was such a wide one that the author only described such tests and arrangements of machines as he thought might be of the most general interest, and was obliged to confine himself to continuous-current machinery.

*Manufacturer's Tests.*—Before the machine is run, the resistance of the armature windings is carefully measured and recorded. Also the insulation between the windings and the frame is tested by the application of a voltage higher than that of the circuit upon which the machine is intended to work.

The armature resistance in the case of small machines, in which the resistance is not very low, is most conveniently measured by the drop of potential method.

For large armatures in which the resistance is less than $\frac{1}{1000}$ ohm, it becomes necessary to use a double bridge method in which the drop of potential in the armature and standard resistance is compared by means of a bridge consisting of four resistances, instead of producing a direct deflection of the galvanometer.

In addition to the measurement of the total armature resistance from brush to brush, it is usual to measure the resistance between every adjacent pair of commutator segments in order to detect any lack of symmetry due to faulty connections by the armature winder, defective joints, &c.

The measurement of the field resistance is usually made at the end of a continued run, when the windings are heated to the normal running temperature.

The resistance of the shunt field winding of a shunt or compound dynamo or motor may be measured with an ordinary Wheatstone bridge, but it is usually more convenient to calculate the resistance from simultaneous readings of current in, and voltage applied to, the winding.

The increase in resistance of the field windings when heated by the exciting current forms the best basis for determining their rise of temperature.

The resistance of a copper conductor increases by ·428 per cent. of its value for each degree Centigrade increase in its temperature. Consequently, in order to find the mean temperature of the coils after they have become heated, the following formula may be employed:—

$$t_c = \frac{r_2 - r_1}{r_1} \times \frac{100}{\cdot 428},$$

where $t_c$ = rise in temperature in degrees Centigrade; $r_1$ = resistance when cold; $r_2$ = resistance when hot.

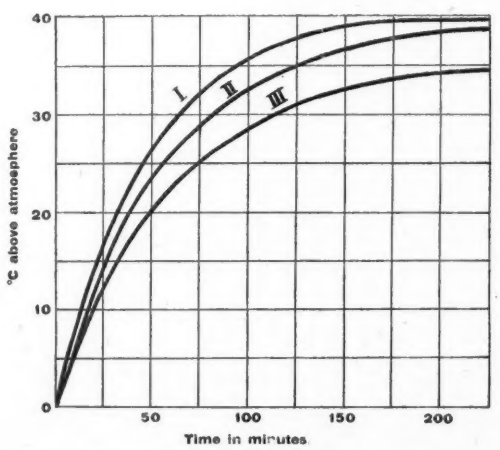



Fig. 1.

If the current supplied to the winding for this measurement is its normal working current, or if the voltage applied at the terminals is the normal working voltage, a series of values of the resistance may be obtained as the winding gradually becomes heated by the current, and its resistance increases in consequence.

The upper curve on fig. 1 shows graphically the result of a determination of the temperature rise in the shunt windings of a small two-pole motor, made in this way. The lower curves on the same figure show simultaneous readings taken with mercury thermometers placed with their bulbs in contact with the windings, and well covered in with cotton-wool to prevent radiation of heat as far as possible. The thermometer, whose readings are shown by the lowest curve, was placed on the outside of one of the magnet limbs. The middle curve gives the readings of a thermometer placed between the magnet limbs against the inner surface of one limb.

The final readings of the thermometer placed against the outside of the windings are seen to be 5° C. below the average temperature

of the coils, as measured by the increase in their resistance. If the average temperature is assumed to be the mean between the hottest and coolest layers, the hottest layer would be about 10° above the temperature indicated on a thermometer applied to the outside of the coil. The depth of winding in this case was only $\frac{3}{4}$ in.

The readings here referred to were taken with the armature stationary. In revolving, the armature fans the coils and cools the outer layers, so that the temperature difference would be much greater with the machine at work.

The hottest layer is found not to be the layer next the magnet limb, since the iron of the magnet cools the layers next it. It is usually about one-quarter of the depth of the winding from the inner layer.

In order to illustrate further the errors to which observations by means of mercury thermometers are liable, the curves on fig. 2 are given. They indicate the readings simultaneously taken on two thermometers placed respectively between the limbs, and on the

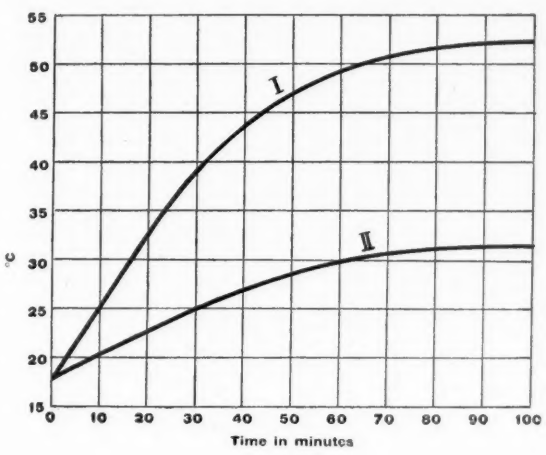



Fig. 2.

outer side of one limb of a small two-pole motor. The thermometers were placed closely against a wrapping of thin fibre with which the windings were protected. The magnets being rather close together, the inner thermometer was in a very well-protected position, and received heat from both magnet limbs. Both thermometer bulbs were covered with cotton wool, and a constant potential was applied to the magnet windings.

It will be seen that the final readings of the thermometers differed by nearly 21° C. A little carelessness in wrapping up the thermometer bulb during a test may cause a still greater error than would be incurred by taking either of the curves in fig. 1 as giving the true temperature of the coils.

The curves sufficiently show how erroneous may be the conclusions as to the temperature of the windings, if only drawn from the readings of a thermometer placed on the outside.

It should be remembered that the actual temperature of the inner layers of the windings must be higher than the temperature indicated by any of the curves, since even the highest curve on fig. 1 only gives the *average* temperature of all the windings.

Mr. E. Brown made some experiments on the internal temperature of dynamo field coils,* and found that in the case of the two-pole dynamo which he experimented upon, the temperature rise of the external layers was 29° C., the average rise through the depth of the winding was 50° C., and the maximum rise was about 60° C. Thus the maximum rise in the interior of the coil was more than double the increase which would have been registered by a thermometer applied at the surface of the coil in the usual way. There was, in fact, quite as large a difference of temperature between the hottest part of the winding and the surface of the coil as there was between the surface of the coil and the air of the room where the test was conducted. These results were obtained with the dynamo running.

The permissible rise in temperature during the trial run, as well as the methods of determining the rise, vary in different factories, and until the report of the Engineering Standards Committee is issued, it is difficult to compare the capacities and outputs of machines by different makers from the nominal output.

The Verband Deutscher Elektrotechniker have issued standard methods of testing and permissible rises of temperature. [These were published in the Elec. Rev., September 13th, 1901.]

The Verband Deutscher Elektrotechniker insist that not only shall the horse-power of an electromotor be stated on its number plate, but also the conditions (such as "continuously working," "intermittent," &c.) under which the output is guaranteed.

This is an important precaution, as it is difficult for the ordinary user to understand why the same machine should sometimes be rated as a 5-h.p. motor, and sometimes as having an output of 7½ h.p. Further, it is important to attach an exact and generally understood meaning to the term "intermittent" as applied to the rating of a motor. The mere fact of stopping and immediately restarting the motor may tend rather to increase the heating of the motor than to enable it to do more work by becoming cooled at each stoppage. This is on account of the fact that starting resistances are often so designed that the starting current of the motor is considerably above its full-load working current.

A motor which after a run of one hour attained a certain final temperature might take considerably longer than one hour to attain its original temperature, and thus, when working with equal periods of work and rest, might ultimately reach a temperature above the safe limit. There is considerable danger of the term "intermittent" being used in such a way as to lead to the employment of a motor unsuited for its work. For example, crane motors are used intermittently, but in some cases a motor rated as above for intermittent working would be seriously overloaded. Thus the motor for travelling or for slewing is in certain cranes in almost constant use for several hours at a time, although used intermittently in the sense of being frequently stopped and re-started.

*Insulation Test.*—While still hot from the trial run, the insulation resistance of the conductors of the machine should be tested by the application of double the working voltage to the insulation between windings and frame. This test should be made quite independently of any other high voltage tests which may be made on the armature or other portions of the machine before being completed. The ability to withstand double the working voltage is far more important than any test of the absolute value of the insulation resistance.

Besides the usual trial run at full load, the magnetic properties of every machine should be tested and recorded by the manufacturer. The records of these tests are of great importance to the

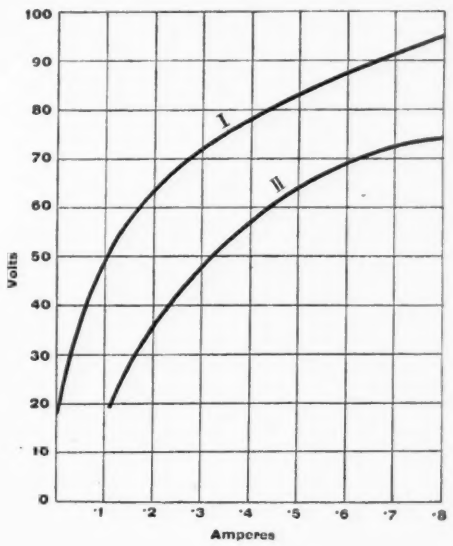



Fig. 3.

manufacturer himself as forming a valuable check on the quality and uniformity of the steel or iron supplied to him for the magnets, as well as to the designer in the case of new designs or special windings. To the purchaser the magnetic properties of his dynamo affect its behaviour when running in parallel with other machines to such a great extent that the results of such tests are of the greatest value. Also the magnetisation curve becomes additionally important if the machine should at a subsequent time be required to be adapted for other conditions than those originally contemplated.

The usual form which the magnetic tests of a newly-completed dynamo take is the determination of the magnetisation curve of the machine on no load and on full load.

The chief importance of the magnetisation curve is to indicate the effect on the voltage of the machine of such variations in exciting current as may occur in actual running. For reasons of economy, the working excitation should correspond to a point on the curve as near the bend as is consistent with stability of voltage within the limits of excitation likely to occur.

A comparison of the magnetisation curves, taken respectively at no load and at constant full load (see fig. 3), shows the variation in voltage to be expected in working, and consequently supplies the necessary data for the choice of a shunt regulator if the machine is to be regulated by such means. If the machine is to work as a compound generator, the curves may be used for determining the series windings to be added. In the case of compound machines required to run in parallel, it is obviously of the greatest importance that the working portions of the magnetisation curves of all such machines should have approximately the same inclination, in order that the variation in voltage of the machines should be similar, and the load be consequently shared by them in the same proportion for all values.

For most practical purposes, the magnetisation curves are more

* *Journal* of the Institution of Electrical Engineers, Vol. xxx., p. 1159.

important than the curve which is usually called the characteristic curve, comparing the machine voltage with its output.

The only other test which may be considered to come under the classification of tests usually made by the manufacturer is the compounding test made in order to ascertain the correct number of series field windings to enable the machine to maintain at full load the same voltage as, or a higher voltage than, at no load, as may be desired.

The usual practice is to send the machines to the test house with the series winding already on the magnets, the approximate number of windings being known from previously built machines. The test is then only carried out in order to ascertain whether the number is absolutely correct, or whether a turn or two should be added or subtracted.

This is done by running the dynamo on open circuit at normal speed, and adjusting the shunt current to give the correct no-load voltage. The armature circuit is then closed and the load current increased to its full load value. Under these conditions, with the machine still kept at normal speed, the voltage should have its specified value if the number of series windings has been correctly computed. If the voltage is found to be either too high or too low, the alteration to be made to the windings must be calculated by reference to the full load magnetisation curve.

In the case of a new type or size of machine, the dynamo is usually tested before the addition of the series windings, and the number of compound turns is then calculated directly from the full-load magnetisation curve in the manner just described.

*(To be concluded.)*

## ELECTRIC LAMP FOR MINERS.

At a recent meeting of the Institution of Mining Engineers, the Neu-Catrice portable electric lamp for miners was described. The base of the lamp consists of a box of sheet lead containing two accumulator cells, made of transparent celluloid or semi-plastic india-rubber. Each cell contains one positive and two negative plates of the Etamp é type. The united elements constitute a small battery of a mean voltage of 3·9 volts, sufficient to supply, for 15 consecutive hours, a small incandescent lamp with a constant illuminating power of about 1 candle. In order to avoid the spilling of the liquid, the electrolyte of these accumulators is fixed by a special process, in such wise that the lamp may be used without risk in any position whatever.

On the lid of the case is fixed an ebonite base which supports a protecting globe of extremely thick glass, and within the thickness of the ebonite base a small opening is cut to allow of charging the cells. A small movable shutter masks this aperture, and is so combined with a switch that the lamp can only be lighted when the charging plug is withdrawn and the shutter is closed. This arrangement is adopted with the view of preventing the current for charging the accumulators (which is at a minimum pressure of 5 volts) from being passed through the lamp.

The lid of the case is locked by a leaden rivet which can be impressed with a stamp, so as to ensure it against being idly tampered with by persons who are not entrusted with the duty of keeping the apparatus in order.

Upon the ebonite base is also fixed a socket to carry the end of the bulb of the small lamp. The upper portion of the protecting globe is held fast (with the interposition of a rubber ring) by a cover, and the latter is connected with the lid of the sheet-steel case by three pillars or poles; finally, a hook riveted to the upper part of the steel cover completes the lamp. The protecting globe is, in regard to one half, painted with a semi-translucent white varnish which acts as a reflector, while allowing a certain amount of light to be diffused backward.

The lamp is made in two sizes: one weighing 3 lbs. 14 ozs., gives 0 8 c.p. during 11 hours, and the other weighing 5 lbs. gives 1 c.p. for 15 hours. The lamp consumes less than 3·5 watts per candle-power and lasts for 500 hours.

To re-charge the lamps a charging table, consisting of 20 or 40 compartments, is used, according as the available E.M.F. is 110 or 220 volts; and a small switchboard comprising a regulating rheostat, an ammeter, a minimum cut-out, a two-way commutator, and a 32-c.p. lamp. When the accumulators are re-charged, before removing the charging plugs they are discharged for 20 minutes on to the 32-c.p. lamp, to prevent over-running the lamps.

The charging current should be 1 ampere, and the duration of charge about 12 hours. The lamp is kept in the lamp room from the time when the workman comes to bank (2 p.m.) until he calls in to fetch it away again the next morning (5 a.m.). For a load of 500 lamps a shunt-wound dynamo of 110 volts and 25 amperes capacity is required.

For the past 15 months, 500 of the larger sized lamps have been in use at No. 1 pit of the Bruay collieries. The cost of maintenance amounts to almost exactly ½d. per diem.

The president, Mr. W. O. Wood, stated that while he was not familiar with the Neu-Catrice lamp, he had in regular use at Murton Colliery some 1,400 Sussmann portable electric lamps. This style of lamp presented considerable advantages, as it was absolutely safe in gaseous atmospheres and very reliable. The bulbs had a life of about 700 hours. The cost was about 3s. per lamp per annum more than that of the ordinary oil lamp, but he thought it was quite worth while to pay this amount, if it was only in the shape of an insurance against explosion, and in fiery mines it was an immense advantage to have a lamp of this description.

## BERRY'S PATENT WATER-TUBE BOILER.

This is one of the medium tube type with tubes nearly vertical. In cross-section it is an inverted w, thus M, with a drum at each of the five points, the central drum at the base being considerably larger than the two outer drums, and the two upper drums a little larger again. The lower drums are joined by short solid-drawn 3-in. tubes in three rows. These are straight, and are over-arched by brick arches abutting on the drums. Below them are the grates, so that the fire on the grate is not really protected from cooling by the over-arch of brick, but is very efficiently robbed of heat by the three banks of tubes which offer, probably, five times the surface that would be exposed in a plain Lancashire furnace. Escaping from the furnaces, the gases then return to the front within the $\wedge$'s, out of which they cannot escape, because of a backing of fire tiles, and again they pass to the back end by the central $\vee$ and along an $\bigcirc$ space formed between the top drums by an upper and lower set of curved tubes. The main heating surface is over the fire in the short tubes. When the gases reach the $\wedge$ passages between the walls of tube they are not compelled to travel between the tubes, but are free to occupy the central void only, and perhaps burn there more completely. We have not seen one of these boilers at work, but understand that there is one at the works of Messrs. Wm. Johnson & Nephew, of Manchester, and that it was made by Messrs. Hewitt & Kellett, of Bradford. We should say, that so far as regards the course of the gases and their chances of mingling well with air, this end will be well secured; but we feel doubts as to whether there is not more heating surface in the furnaces than is good for the thoroughly successful combustion of bituminous fuels. In the boiler at Messrs.



Berry's Patent Water-tube Boiler, with Superheater and Underfeed Stoker.

Johnson's works there is a single upper drum only, and, therefore, no central [V] passage. Instead, there is a vertical wall of firebrick unprotected by tubes, and this should make the combustion probably more smokeless than in the five-drum type.

The water from which the boiler is fed is stated to contain 42 grains of solid matter per gallon, and to give no trouble in the boiler. It is also claimed that, being self-contained to a very large extent, the seating of this boiler is inexpensive. The front and back closing walls are made with an air cavity of 3 in. The height from the floor is 13 ft. 6 in. to the centre of the upper drum. In the five-drum type, this dimension is 15 ft. 6 in., the heating surface is 2,700 sq. ft., and the grate area is 49 sq. ft. A superheater is placed at the back end to be heated by the gases immediately after they have left the furnace, but before they pass between the tubes above the fire-brick arch; the superheater can be shut off by means of dampers, as shown in the fig. opposite. The ratio of grate to heating surface is about 1 to 55, for which the total overall width of the boiler is 14 ft., and it is 20 ft. 6 in. to the centre of the steam outlet pipe. The overall length of the top drum is about 17 ft. The whole boiler is not badly arranged for inspection, and with modifications suggested by experience, which will, we fancy, include a change of the lower tube arrangement, the boiler should have its share of success; but, unless a secondary combustion is obtained in the ∧ chambers, the combustion in the furnace will be very seriously injured by the tubular roof, and nothing could be worse than this furnace roof for smoke prevention. In the ∧ chambers the gases are not compelled to pass among the tubes, so that combustion may take place there, and there is in this some mitigation of what cannot but be regarded as a serious error in design. It will, however, be very easy to omit the roof tubes altogether, and replace them by large external water pipes to afford the necessary circulation. As the boiler stands, it should be excellent and effective for coke, anthracite, or producer gas.

## THE REPORT OF THE MOSELY EDUCATIONAL COMMISSION.

(*Concluded from page* 646.)

Mr. Mosely, who wrote such a masterly review of the general position of affairs in the labour report, has scarcely achieved a like success on the present occasion. He gives us an interesting piece of autobiography which explains how he was led to conceive and carry through his two commissions. Mining at Kimberley, he says, was unremunerative till Gardner Williams, the Californian engineer, arrived in South Africa, and took over the management of the De Beers Co. He imported the late Louis Seymour, to whose work in Natal during the early stages of the Boer War the British nation owes much. Other Americans followed, and the results of their labours induced Mr. Mosely to journey to the States to see what sort of country it was that had sent so many level-headed men to the Cape. Mr. Mosely thinks British boys leave school at too early an age, that the American boy is infinitely better fitted for his vocation, that the American system makes every boy fit for something; and that, consequently, fewer slide downhill to reinforce the pauper, criminal, and "submerged-tenth" classes. The presidents and professors of educational establishments are not only men of high academic attainments, but possess the initiative and organising capacities required in managers of industrial or commercial undertakings. Mr. Mosely does not consider the Americans materialistic, they are intensely ambitious—ambitious to raise themselves individually, to raise their fellow countrymen, and to further civilisation. As there is yet practically no inheritance of wealth in the States, rich men have earned their money; and, since acquisition of wealth is a proof of "remarkable ability and brain power," what is often stigmatised as the aristocracy of money, is an aristocracy of brains. This line of argument, however, is clearly open to attack, for the self-made rich man is not always distinguished for anything in the way of education or intellect beyond a power or gift for amassing money. Mr. Mosely himself says that successful men are, to a large extent, born, not made.

We come now to a study of the individual reports written by the exponents of science. Prof. Ayrton deals principally with the absence of the premium apprentice from the States, and with the way in which college professors are encouraged to carry on a consulting practice. At the Westinghouse Electric and Manufacturing Works, where some 10,000 men are usually employed, there are about 150 engineering apprentices, who must be first-class graduates of leading technical schools. They are paid 8d. per hour from the start, and may be earning £30 a month in eight months' time. Officials of the company visit all the principal colleges, &c., every year, choosing the most suitable pupils; and, as appears from other reports, there is actually a fierce competition between the various engineering concerns to secure these lads. At Columbia, Prof. Hutton has had 70 of the engineering students engaged before graduation. Prof. Ayrton tells us of a young English graduate of Victoria University who had entered an English electrical works as a £150 premium pupil. At the end of the first year he had learnt so little that the contract was determined, and he went to Pittsburg. The Westinghouse Co. also takes about 80 non-technical apprentices to be trained as machinists, "who correspond more with what the English apprentice has become." They are taken on trial for 685 hours at 2½d., and if worth keeping may be earning 7½d. in their fourth year, at the end of which they receive a bonus of £20 and a diploma. At Union College, Schenectady, lectures are given alternately by a member of the faculty and by one of the General Electric Co.'s staff. The students have the free run of the factory; the professor brings his whole class to the works for a forenoon or day, "using the factory as his lecture apparatus." During vacation time any engineering student can come into the shops and earn a moderate salary at armature winding, or in the testing room. Thirty per cent. of the G.E. Co.'s students are British, and within five months "they drop into step and hustle," according to Mr. Steinmetz. The engineering staff of the Rapid Transit Railroad, New York, comprises 118 men; 100 of them, or 84·7 per cent., are college trained. They are chosen by examination, and receive £20 per month to start with. Having seen the papers, Prof. Ayrton states that the examination does not unduly favour the college man at the expense of him who entered on practical work when quite young.

Engineering professors are not "occasionally permitted" to do outside work, they are "practically compelled" by the college authorities to do so much that they become recognised in the world as the working authorities on their subjects. Representative Americans said: "We don't know a successful engineering professor who is not . . . . successful in outside work." The colleges give their professors leave of absence extending over days or months for the pursuit of their private practice, arguing that the students gain by the fresh experience the professor brings back. Mr. Kerr, formerly a professor at Cornell, and now president of Westinghouse, Church, Kerr & Co., has actually suggested that Chairs might be filled by two men, who should serve alternately two, three, or four years in the college and in the works. The fees thus earned by the professors exceed their salaries; they are also permitted to do private work in the college laboratories, retaining 50 or even 90 per cent. of the fees payable. Sarcastically remembering that a British professor of surgery or music is not held to neglect his pupils because he operates or appears at concerts, Prof. Ayrton repeatedly suggested this objection to his American interlocutors. The reply was: "The man who spends all his time at the college slips behind. If a man is good enough to be a professor he can be trusted to be fair; if he is going to rob us, he is not good enough to be at the college at all."

As regards teaching, Americans think that the greatest development in each branch is to be secured by drawing lines vertically between sections of the subject and not horizontally between students of different ages. Ante and post graduate students of the same subject should be together, so that the former may not think it their sole duty to acquire, and the latter to advance, knowledge. But one professor with his staff should teach, say, all the electric traction, another all the telegraphy and telephony, and a third the design, manufacture, and testing of heavy electric machinery. This organisation is also to be found in the large factories, where one man is expected to be the authority on direct current machinery only, another on single-phase alternating current machinery only, a third on polyphase machinery only, &c. In the works of the Westinghouse and the G.E. Companies departments are set aside for experiment and research—the motto throughout being "Originate, don't copy."

Prof. Maclean, the other electrical commissioner, is greatly struck with the recent institution of the present educational

system, the secondary and technical schools of the States only dating, as a rule, from the close of the Civil War. Hence the men who have already made their mark and hold commanding positions, as well as many outstanding leaders of industry, did not have the advantages offered to the rising generation. The newness and undeveloped nature of the country, its isolation and freedom, the immigration of people of fine physique and intelligence—for as one of the other writers says, only men of enterprise leave their native countries—all these things, rather than education, have made the United States what it is; but now education is stepping in to manage and control the existing conditions, without whose aid the huge mechanism of State and industry must needs collapse. The educational system is still in its experimental stage, subject to modification and revision (as many commissioners observe); but hitherto it has proved itself more or less adequate to the enormous demands made upon it, and that is why it is evoking so much attention. Employers say that young men who have been trained in technical schools are broader minded, and have a wider mental grasp than youths who left school at 16 to learn their trade in a shop. In all kinds of work, the former receive at first no higher wages than the latter; but the pay rapidly increases to a figure beyond that given to the untrained class, because the technical training soon renders its recipient more efficient and valuable that the tradesman can ever become. Of the various methods by which workmen (and ultimate foremen) can acquire a trade or technical education, Prof. Maclean favours most the plan of letting them stay three or four years in the shops before going to evening technical schools, or that of causing the apprentices to attend school while serving. But in this connection it is very desirable to remember, as Mr. Blair has properly shown, that to spend all day in the works and five evenings a week in the school for eight months in the year, may well be imposing too severe a strain on the best material of the country at a very critical age. Prof. Maclean devotes some space to matters we have already dealt with, *e.g.*, the advantages of the American apprenticeship system, the "accrediting" of certain secondary schools by some colleges and universities, the granting of degrees according to the student's record and his thesis instead of after a "final," the administrative ability and consulting practices of the professors, the method of oral questioning and inter-discussion among the pupils and teachers. Prof. Maclean considers the training of a high order, but no better (sometimes worse) than ours. American students, however, acquire much greater knowledge of machine work than British lads, and so meet in the shops no apparatus with which they are not familiar. The technical colleges have departmental libraries supplied with all the scientific and special journals—once a week each student has to give a summary of the more important articles published in those which have been assigned to him.

Like Prof. Maclean, Prof. Ripper writes much in the same strain as Prof. Ayrton about special matters, while his general views are incorporated in the former part of our review. According to Dr. J. H. Camfield, 1 per cent. of the entire population of the United States has received a higher education, and this 1 per cent. holds over 40 per cent. of all the positions of confidence, trust, and profit, which it is in the power of the people to grant. In 1900, 89 institutions in America were teaching 9,679 students engineering, and the pupils were all over 18. In the United Kingdom there were 2,259 engineering students in the same year, the majority of whom began their studies at 15. Yet English and Scottish foremen, managers, and heads of departments, are to be found all over the States, holding their positions by merit. Most of them are the product of the British evening science class, which is much and unjustly disparaged in America. There is no organisation of evening work comparable with that of the Science and Art Department; the nearest approach is to be found in the Y.M.C.A., which is everywhere remarkably strong, but mainly directs its educational efforts to elementary commercial subjects. Prof. Ripper gives us some useful conclusions; but, broadly speaking, they may be read in the General Report, and in what we have already written.

Prof. Armstrong would almost seem to have drawn up his report when the wind was easterly; he finds little to admire in America, except the way in which science is made to serve the State in the United States Department of Agriculture. All the faults of Great Britain recur in the States; too academic a system of teaching; neglect of writing and composition; old-fashioned methods of teaching mathematics and geometry; ineffective control of, and political interference with, the schools; absence of femininity in the women; over-teaching; too much routine work and too little research in the colleges. Other matters dealt with by Prof. Armstrong have gone before, but his final paragraph is worth reproduction, because, with due allowance for his pessimism, it resembles in many respects Prof. Ayrton's last words, which we quote lower down. Dr. Armstrong says:—"It is quite clear that the right spirit is at work in the United States; but the lack of the critical faculty and of depth of purpose, combined with an excessive development of the utilitarian spirit, are serious drawbacks at present, and militate against progress in education. Until higher ideals prevail, and sober calculation takes the place of a somewhat emotional and superficial consideration of its problems, it will be difficult to introduce reforms. Here our difficulty is to break through academic, conservative traditions, and to arouse an interest in education: that in reality it is the most important of all subjects to be seriously considered has never yet been made clear to us, either by preacher or by politician—the message awaits delivery, and we need more than anything else the man to make it heard."

Several of Mr. Mosely's commissioners write of the system of giving instruction by correspondence, and speak of it with measured praise. The chief school is at Scranton, Pa., which has on its books the names of 135,000 persons, and has given information to over half a million in the 10 years since it was started. The institution has offices in 28 different towns, and employs 3,200 assistants, including travellers of the commercial kind, a "field force" of 1,000, and 1,100 men in the office correcting papers, composing text-books, and drawing diagrams. Profs. Maclean and Ripper admit that the magnitude of its operations shows that the system fulfils a distinct want; and if some of the books, &c., are superficial, it must be remembered that the students are ignorant, and are taking the only means open to them of gaining knowledge. "We take a man engaged in a particular trade and teach him the theory of that trade, we confine ourselves to that," is what the Scranton officials say.

Prof. Reichel (Principal of University College of North Wales, Bangor), deals at some length with Canada, where he appears to find matters on the English rather than on the American plane. The schools, he says, are more traditional in tone, less "co-operative," more dominated by prizes, less dependent upon women teachers, less given to affording manual training, and prone to make the courses shorter than in the States.

Space will not permit us to deal with the many interesting matters contained in the reports of the non-technical commissioners beyond incorporating some of them, as we have attempted to do, in our general review. On the whole, perhaps, the general tenour of the entire report is best summed up by Prof. Ayrton, whose words, though he writes for himself alone, would, we take it, be subscribed willingly by all the other men of science, if not by Mr. Mosely's investigators *en masse*:—"A comparison between students in the two countries shows that the American student is usually not as scholarly, nor as well read, as the English student of the same age; but 'he has his knowledge in a better form to apply.' The British system turns out a man full of knowledge and principles, while the American product is a business man with a scientific training. The characteristics of each nation have their advantages. To America we look for that rapid, bold, and successful application of science to industry which has brought about the commercial invasion of the world, while to Europe we look for those scientific imaginings and creations which are apparently so unimportant to-day, but which to-morrow revolutionise old industries and give birth to new ones."

. . . . . .

The report, we are asked to state, will be sold to the general public at the price of 1s., but copies will be supplied free to accredited members of educational authorities, county councillors, local managers and teachers within the British Isles, who enclose the sum of 4d. for postage, on application to the Co-operative Printing Society, Ltd., Tudor Street, E.C.

## ELECTRO-PEAT "COAL."

When, some months ago, we attended at the works of Messrs. Johnson & Phillips to witness a demonstration of the electro-peat fuel process, we came to the conclusion that the process had not so much value as would justify an investor in risking more than twopence five-eighths in helping it on. Indeed, we hoped that the promoters would see their venture in such a light as would convince them that it would not be desirable to invite any public support. On that occasion our representative tried to elicit information from the gentleman who was there specially to afford it, and the manner of his reply was stated at the time (see Electrical Review, November 13th, 1903). As a fact, there was no information afforded that was of any value in helping to arrive at an estimate of the cost of the process. We are of opinion that the electrical action, for which so much is claimed, is non-existent, save only as regards the heat generated, and that this generated heat could be furnished in another way for perhaps a twentieth of what it costs by way of steam boiler, engine, dynamo and $C^2R$ effect. We were not alone in endeavouring to indicate the fallacy of the idea underlying the claims made. The promoters, however, apparently value our opinion so little that they now submit to us the prospectus they have issued, with reprints from various financial and daily papers, the value of which will be duly appreciated by those who are familiar with the technical training possessed by the lay Press man.

A letter from a patent agent is also enclosed, which is of no value as regards the process, and is such a letter as could quite honourably be written by a patent agent on a specification for extracting cobwebs from shavings, for probably he would find no prior claim, and this is what he tells us he has not found *in re* the electrical treatment of peat, for which let us be thankful.

Then a chemist has tested peat "coal," and finds from 16,341 to 18,095 B.Th.U. We will not say he is in error, but we doubt the accuracy of his calorimeter, which shows for peat 2,000 units in excess of the best coal, and a calorific capacity nearly equal to that of petroleum crude oil. In this connection, however, there occurs a very significant figure.

In the report of the engineer who submitted the sample to the chemist, these and other extraordinary calorific values would appear to have been based on the combustion of 1 kilogram, or 2·204 lbs. of the peat fuel.

Not a word is said in Mr. de Hailes's report of the kilogram, and we have a right to infer that a quotation in B.Th.U. refers to a weight of 1 lb. Now, in Mr. Scoone's report we find that the B.Th.U. are found to be from 13,095 to 17,460 on the basis of the combustion of 1 kilogram, which is a very erroneous, ambiguous and unscientific method of stating calorific values. The chemist asks us to believe some 18,000 B.Th.U. per lb. by his way of writing the report. The engineer who is full of thermal units can turn round in the sequel and point to the very casual use of the word kilogram. Those who know of these values will read between the lines 6,000 or 8,000 B.Th.U. per lb. The lay brother will perhaps look up a pocket book and conclude that peat is better than best Welsh.

We decline to express our opinion of these reports, both that of the chemist and that of the engineer, but having called attention to these curious statements, will waste no more space on the equally valuable remaining paragraphs of the reports.

The letter of Messrs. Johnson & Phillips is a mere platitude, and contains one or two truthful statements, of no value whatever as a certificate to the merits of the principle, but it lends the firm's name to the undertaking. Mr. Fletcher Moulton's opinion is practically confined to the novelty of the claim, but a novel claim for a process of doubtful value is of no more value than the process. Mr. Moulton's certificate has no bearing on the process.

We particularly regret the issue of this prospectus, because it will probably do an incalculable amount of harm to Ireland generally and to the peat industry in particular.

When we were at Charlton we noticed that the freshly-made peat briquets were more than sodden. Small, partly-dried briquets were brought in a letter basket from some place out of sight. Three of these are before us as we write, marked respectively 2·75, 3·375, and 5·5 (ounces). They now weigh 1·7, 2·17, and 3·25 ozs. on the same scale on which they were first weighed, having lost about 38, 36, and 40 per cent. of the supposed dry weight, as handed over to us. They have lain for weeks since then, drying out in a book-case drawer.

Peat, as found in Ireland, contains at least 80 per cent. water. The electrical treatment hardly dries out any of this, and all the electricity that could be generated by the burning of dried peat could not, we imagine, dry out an equal further quantity of so-called "dry" peat. We have no belief in the claims made for the peculiar effect of electricity. There is no scheme put forward to show how the peat is to be garnered from the bog, and without a thorough mechanical scheme for this no process can be worth sixpence. We would not touch the electrical process, even if the peat were dumped down free at a works on the Thames.

The parent company is to be floated for £130,000, of which £65,000 goes to the promoting syndicate.

That peat may be made into a good, dry, valuable fuel we believe to be quite possible, but the day when this will be done will be pushed further into the future by every such ill-considered scheme as that put forward by the Electro-Peat Coal Syndicate.

They cannot say they have not been warned. In the whole of the large four-page sheet of Press opinions, we find but one from a technical paper of any sort, and that very guarded and non-committal. Where are the extracts from the remarks of the technical Press at the time of the Charlton tests? There is one little rift of humour in all this; the patent agent has searched back to 1620 to find *electrical* methods of peat manufacture!!!

Raw peat is admitted to contain 86·5 per cent. of water. To evaporate this by direct heating would require, say, 1,100 × ·865 = 950 Th.U. per lb. of raw peat. There would remain 13·5 per cent. of dry peat. At 10,000 B.Th.U. per lb. this would provide 1,350 B.Th.U. Of each pound of dried peat only 400 units would remain over, so that two-thirds of the peat would be burned to produce one-third of dry briquets. The centrifugal drying would reduce this waste, but there is no monopoly in the centrifugal drying of peat. Before investors risk a penny in this thing, let them obtain advice from other experts than those put forward by the promoters. If not, they will have themselves to blame if they lose their capital. Finally, let us draw a veil over the projected very profitable promotion of numerous (200, to wit) subsidiary companies.

## THE BRUSH-GUTMANN INTEGRATING WATTMETER.

From the time, about 20 years ago, when electricity supply became an established business, and it was seen that a fixed charge per lamp for energy was not likely to attract customers who were used to gas accounts, the problem of designing a sound electricity meter has engaged much attention.

Early meters were naturally of the electrolytic pattern to suit the direct-current that was at first supplied; later on appeared the direct-current motor type. When alternating supply became general, meters were produced to suit the new conditions. Among these the Gutmann integrating wattmeter is a noteworthy example by reason of the excellence of its electrical and mechanical design, and the care employed in the selection and treatment of its material.

On the following page we give illustrations of the meter, with its aluminium cover in place and removed. From these it will be gathered that the instrument is compact, the overall dimensions being only 8¾ in. × 6⅝ in. × 6¼ in., and the weight 10½ lbs. It is designed also for switchboard use, and for this purpose meters with strong glass covers are supplied, to render the working parts largely observable.

The Brush Electrical Engineering Co., Ltd., are placing this meter on the British and Colonial market, and a short general description is therefore opportune.

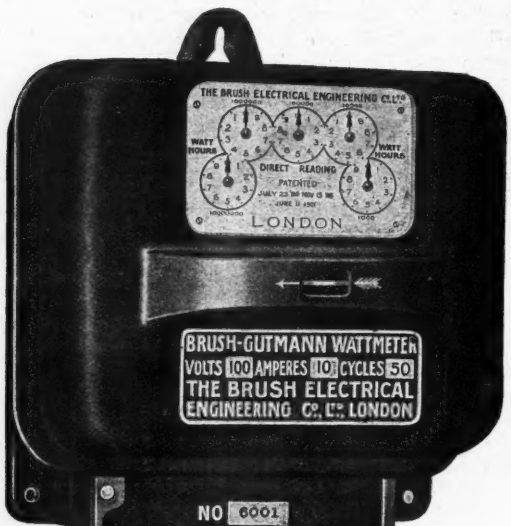
The armature consists of a thin aluminium disc, slotted in peculiar spiral lines to obtain the highest possible torque; the disc is carried on a slender steel spindle. This spindle is turned and polished at the lower end to a fine ball-shaped pivot, and at its upper extremity carries a worm of special alloy which does not rust. The motion is transmitted through the worm to the recording train. The weight of the disc and spindle is very small, so that

the jewel in the lower bearing is subjected to no appreciable pressure.

The permanent magnet is an extremely important element, as a slight change in its strength will affect the accuracy of the meter. It is, therefore, an item upon which a great deal of time and money has been spent, and the methods of preparation and treatment give results satisfactory in a very high degree.

The meter is securely sealed, dust and damp-proof, and is suitable for the following circuits:—

(*a*) *Secondary.*—The standard single-phase two-wire meters are for 45 to 60, 100 to 115, and 200 to 220 volts. Meters above 100




The Brush-Gutmann Integrating Wattmeter.

amperes capacity are furnished with series transformers, reducing the maximum current in the series coils to 5 amperes; those above 250 volts have also a pressure transformer. For three-wire circuits the standard two-wire meter is used. For meters below 50 amperes the connecting box is made so that the series coils of the meter are

The Brush-Gutmann Meter; Cover Removed.

connected to each of the outers. To meters above 50 amperes a series transformer is attached, with two primary coils and one secondary. For balanced two and three-phase circuits the same type of meter as the single-phase two-wire standard is employed.

(*b*) *Primary.*—Meters for primary circuits are similar in general design to the secondary meters, but the series coils and main terminals have extra high insulation, and a pressure transformer is provided. Meters above 50 amperes have also a series transformer. The standard voltages are 1,000, 2,000, 5,000, and 10,000.

Ordinary variations of frequency do not alter the accuracy. Difference in wave form has no bad effect, and loads of the lowest power factors are recorded as correctly as non-inducive loads. Creeping is absent on no load even where there is vibration. The starting load is very small and permanent overloads of 50 per cent. or temporary overloads of 100 per cent. are permissible. The loss in the shunt coil varies from ½ to 3 watts, depending upon the voltage and frequency. The drop in pressure through the series coils is about 0·25 volt in small meters, and less in those of greater capacity. The readings are direct in watt-hours, and true within a small percentage from starting load to 50 per cent. overload. Ordinary changes of temperature have no effect upon the accuracy. The capacities range from 2½ to 1,000 amperes. The meter has only one size of case whatever the capacity, and can be fixed by any ordinary wireman as no adjustment is required. It can also be tested on site if desired.

The Brush Co. guarantee every meter for a period of two years, provided the seal is unbroken and the cover has not been opened.

## NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

7,823. "Telephone transmitters." W. Fairweather. (American Electric Telephone Co., United States.) April 5th. (Complete.)

7,833. "Improvements in and relating to the ventilation and drying of electric transformers and electrical apparatus." L. R. Lee. April 5th.

7,838. "Improvements in or connected with medico-electrical apparatus." J. Trotter. April 5th.

7,869. "An improved automatic power cut-out for electric railways." H. F. Pieper. April 5th. (Complete.)

7,987. "Improvements in and relating to electric meters." B. Krausse. April 6th.

7,977. "Improvements in receiving devices for use in wireless telegraphy." G. Möller. (Date applied for under Patents Act, 1901, May 2nd, 1903, being date of application in Denmark.) April 6th. (Complete.)

7,980. "Improvements in or connected with electric fuses or cut-outs." J. H. Mercadier. (Date applied for under Patents Act, 1901, April 7th, 1903, being date of application in France.) April 6th. (Complete.)

7,985. "Improvements relating to attachments for electric incandescent lamps." H. D'Olier, jun. April 6th.

8,001. "Improvements relating to electric brushes and the like." T. Morris. April 7th.

8,024. "Improvements in electrical interruptors." A. E. Burton and T. J. Leach. April 7th.

8,064. "Improvements in or relating to the working of single lines of railway on the electric staff or other electric systems." C. M. Jacobs. April 7th.

8,077. "Improvements in or relating to the trolley heads of electric tramcars and the like." S. R. Thompson. April 8th.

8,078. "Improvements in tubes or conduits and like means of carrying electric or other conductors." J. F. Davie. April 8th.

8,079. "An improved shade carrier for electric or other lights." E. Phillips. April 8th.

8,096. "Improved means or device for catching and supporting overhead electric cables or wires when fractured." H. W. D. Ingham and T. M. Jones. April 8th.

8,103. "Improvements in electric lifting and hauling machinery." C. G. Major, E. C. Stevens and P. H. Stevens. April 8th.

8,134. "Improvements in automatic regulating apparatus, especially adapted for use in electricity generating stations." F. R. Webb. April 8th.

8,139. "An improved bayonet collar for electric lamps and the like." L. Barlow. April 9th.

8,188. "Improvements in and relating to electrical insulation." P. R. Taylor. April 9th.

8,216. "An improved electric furnace for converting pig-iron into steel." G. Gin. April 9th. (Complete.)

8,221. "Improvements relating to electric tramways and railways working on the overhead trolley system." A. E. McCracken. April 9th.

8,227. "Improvements in alternating current motors." A. P. Zani. April 9th.

8,234. "Improvements in telegraphic signalling apparatus." A. G. Bloxam. (J. Goffin, Belgium.) April 9th. (Complete.)

8,235. "Improvements in systems of electrical distribution." J. S. Peck. (Date applied for under Patents, Act, 1901, May 1st, 1903, being date of application in United States.) April 9th. (Complete.)

**Fan Motors.**—The Rhodes Electrical Manufacturing Co., Ltd., have secured from Messrs. Heenan & Froude, Ltd., a contract for the supply of the first lot of motors for coupling up to their ventilating fans to be used in connection with the Underground Electric Railways Co. of London, Ltd., for the ventilating of the Baker Street and Waterloo railway. We understand that the Rhodes Co. are exceedingly busy, orders and output since the beginning of the year having been over double that of the corresponding period of last year; they have laid down a quantity of additional plant and tools in order to cope with the increase in business, and for the same reason have made considerable constructional alterations in their factory. The company are now in a position to quote for any sizes of alternating current machines up to 30 H.P., single or polyphase.